

**PRIME HOOK NATIONAL WILDLIFE REFUGE  
FIRE MANAGEMENT PLAN APPROVAL**

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## **1.0 Introduction**

### **1.1 Purpose of the Fire Management Plan**

The goal of wildland fire management is to plan and implement actions that help accomplish the mission of the National Wildlife Refuge System, which is “to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (095 FW 3.2).

This plan is written to meet Department of the Interior and U.S. Fish and Wildlife Service (FWS) requirements that every area with burnable vegetation have an approved Fire Management Plan (FMP). This plan updates the FMP approved in 2002. The updated plan incorporates new interagency and FWS fire management policy and procedures. It is written with the intent of integrating all wildland fire management and related activities within the context of an approved Comprehensive Conservation Plan (CCP) for Prime Hook National Wildlife Refuge (NWR). This FMP will guide all the wildland fire management activities of the Refuge, including wildfire preparedness, use of prescribed fire and other tools to treat hazardous fuels and habitats, appropriate management response, and treatment monitoring. Values to be protected include Refuge structures and improvements, cultural and historical sites, neighboring private properties, endangered, threatened, and species of special concern, and the habitats that benefit these species.

The Fire Management Plan will be reviewed annually to ensure the fire program advances and evolves in step with the Service’s mission and the Refuge’s purposes. FMPs will be revised at a minimum of five-year intervals or when significant changes are proposed, such as might occur if significant land use changes are made adjacent to FWS lands (621 FW 2.3 C-4).

### **1.2 General Description of the Area in the Fire Management Plan**

Prime Hook NWR lies along the eastern coast of Delaware, just north of Cape Henlopen, near Milton, a small community of coastal Sussex County, about 22 miles southeast of Dover, the State capital. The Refuge is in a semi-rural, agricultural area west of Delaware Bay, within a two hour drive from Baltimore, Maryland, Wilmington, Delaware, Washington D.C., and Philadelphia, Pennsylvania. The Refuge is 12 miles north of the beach resort communities and just east of the major state north-south route from the cities to these resort areas. Delaware Bay is one of the world’s busiest channels for barge transport of oil and petroleum products. (See Appendix Map A1 - Refuge vicinity map.)

Prime Hook NWR was named by European settlers in the 17<sup>th</sup> century for its abundance of purple beach plums. (Translated from the Dutch, Priume Hoek means Plum Point.) Historically, many farms and residences were on lands now comprising the Refuge. Agriculture is still the dominant industry in Sussex County, one of the fastest growing counties on the East Coast. Tourism is the County’s second-largest industry. During the 1980’s and 1990’s, extensive development began; i.e. vacation homes, retirement communities, golf courses, and shopping malls.

Almost all Refuge lands lie below 10 feet mean sea level. Nearly 80% of the Refuge is wetland habitat, freshwater and salt marshes with associated tidal streams and fresh water creek drainages terminating in Delaware Bay. Other habitat includes sandy beaches, scattered forests, scrub/shrub, and upland areas. (See Table 1 for Refuge habitat types and acreages.)

### **1.3 Significant Values to Protect**

In 1962, the Refuge was established to protect and preserve coastal wetlands along the Delaware Bay for migratory birds. Later, lands were also acquired for the purpose of conserving threatened and endangered species, the protection of natural resources and developing fish and wildlife recreation. Prime Hook NWR's statutory purposes are based upon land acquisition documents and legislative authorities. For lands acquired under the Migratory Bird Conservation Act (8,356 acres), 16 USC 715-715r, as amended, the purpose of acquisition is "...for use as an inviolate sanctuary, or for any other management purposes, for migratory birds." For the 949 acres of lands acquired under the Refuge Recreation Act, the purpose is "... (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered or threatened species..."

Refuge habitats, including 827 acres of easements, total 10,132 acres. These habitats are dominated by emergent wetlands interspersed with swamp and upland forests representative of the Delmarva Coastal Plain ecosystem. The Refuge's vegetation cover types are shaped by tidal and freshwater creek drainages that discharge into the Delaware Bay with associated coastal marsh habitats. Less than twenty percent of the Refuge is composed of upland habitat types. National Vegetation Classification System (NVCS) cover typing of Prime Hook NWR has delineated 37 land cover types including vegetation and anthropogenic communities and water surface coverage. NVCS communities have been lumped into eight general vegetation classes for easier depiction of cover-types across the Refuge landscape (Appendix Map A3-Refuge Vegetation Cover Type Map).

In 1986, the endangered Delmarva Fox Squirrel (DFS) was re-introduced to the Refuge. The Refuge DFS population is a successful one and will likely be the core population for expanding DFS habitats in the coming years. The DFS is the only federally endangered species known to reside year-round on the Refuge; its primary habitat is the upland forest. Low intensity fires in this habitat may benefit the DFS. Piping plover (also federally endangered) uses Refuge habitats in the spring, summer, and fall. In addition, the Refuge contains state-listed species, including rare bog plant species, the bald eagle, American oystercatcher, least and common terns, pied-billed grebe, black crown night heron, Northern harrier, and Cooper's hawk.

A portion of Fowler Beach is a horseshoe crab sanctuary designated in 2006, with interagency partners. The horseshoe crab provides food for 11 species including shorebirds and sea turtles. Fowler Beach is the last remaining stretch of undeveloped beach in Delaware. Included in the sanctuary are vegetated dunes west of the beach itself. Efforts to purchase the stretch of beach from Fowler Beach to Prime Hook Beach are underway, to ensure its protection and conservation.

Refuge facilities include an office/visitor center, three maintenance shops, an old office, a residence, several storage structures, an environmental pavilion, a boardwalk trail, numerous observation platforms, photo blinds, kiosks, elevated deer platforms and entrance signs, the Island Farm Bridge, and an accessible fishing pier. (See Appendix Map A2.) The estimated facility replacement cost is \$2.4 million, per a database maintained by the Refuge. In addition to Service facilities, there is a facility owned and operated by the Federal Aviation Administration.

Three beachfront communities lie just east of Refuge lands. There is a major focus on reducing the risk to these communities from periodic human-caused fires which have threatened them in the past. Slaughter Beach, Prime Hook Beach and Broadkill Beach were identified by the Delaware State Forester and included in the nation-wide list of Highest Risk Communities in the vicinity of federal lands published in August 2002 in the *Federal Register*. There are over 750 homes in this Wildland-Urban Interface (WUI) area, valued at approximately \$300 million. Road access to each community is one way in/one way out. The communities are characterized by narrow, easily congested lanes and lack of defensible space (See Appendix Map A4 – Refuge WUI Treatment Map).

Along other portions of the refuge boundary, there are scattered homes, such as those near the golf course, that present less of a WUI issue.

The intensively managed freshwater impoundments are important feeding and resting stop-over sites for spring and fall migrating shorebirds and wading birds, and migrating and wintering waterfowl. Neotropical migrants utilize the Refuge's upland forested habitat during the fall and spring. The Refuge has almost 2,300 acres of tidal saltmarsh, a rapidly diminishing habitat type on the coastline of the Eastern U.S.

The Service handbook “Identifying Refuge Resources of Concern and Management Priorities” was used to determine focal species and priority habitats (Table 2). Priority habitats are essential to achieve Refuge purposes and to address issues of biological integrity, diversity and environmental health of focal migratory bird species, inter-jurisdictional fish, federal threatened and endangered species, and state species and habitats of special concern. Sensitive habitats include Oak Island, First Hill, Second Hill, Negro Island, and Horse Island which serve as the core Bald Eagle Management areas, exemplary peat bog communities and coastal plain depressions and ponds. Other sensitive areas include habitats critical for both state and federally endangered species. (See Wildlife sections in Chapter 3 for more details).

Six prehistoric artifact concentrations, four prehistoric “find spots,” and three historic artifact areas have been identified. Three historic sites are eligible for inclusion in the National Register of Historic Places. Oak Island is a sensitive cultural resource area. More details are in Chapter 3.

The Refuge provides compatible wildlife-oriented recreational opportunities consistent with the National Wildlife Refuge System Improvement Act of 1997, such as hunting, fishing, wildlife observation, photography, environmental education, and environmental interpretation.

## **2.0 Policy, Land Management Planning and Partnerships**

### **2.1 Implementation of Fire Policy**

#### **2.1.1 Federal Wildland Fire Policy**

This FMP meets the Federal Wildland Fire Management Policy by implementing the following guiding principles:

- Firefighter and public safety is the first priority in every fire management activity.
- The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the planning process. Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.
- Fire management plans, programs, and activities support land and resource management plans and their implementation.
- Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity.
- Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.
- Fire management plans and activities are based upon the best available science.
- Fire management plans and activities incorporate public health and environmental quality considerations.
- Federal, State, Tribal, local, interagency, and international coordination and cooperation are essential.
- Standardization of policies and procedures among federal agencies is an ongoing objective.

#### **2.1.2 National Fire Plan**

This FMP meets the policy and direction of the National Fire Plan direction by emphasizing the primary goals of the 10 Year Comprehensive Strategy and Cohesive Strategy for Protecting People and Sustaining Natural Resources: improving fire prevention and suppression, reducing hazardous fuels, restoring fire-adapted ecosystems, and promoting community assistance.



### 2.1.3 Department of Interior (DOI) Fire Policy

This FMP incorporates and adheres to DOI policy stated in 620 DM 1 by giving full consideration to use of wildland fire as a natural process and tool during the land management planning process and by providing for the following:

- Wildland fires, whether on or adjacent to lands administered by the Department, which threaten life, improvements, or are determined to be a threat to natural and cultural resources or improvements under the Department's jurisdiction, will be considered emergencies and their suppression given priority over other Departmental programs.
- Bureaus shall cooperate in the development of interagency preparedness plans to ensure timely recognition of approaching critical wildland fire situations; to establish processes for analyzing situations and establishing priorities, and for implementing appropriate management responses to these situations.
- Bureaus will enforce rules and regulations concerning the unauthorized ignition of wildland fires, and aggressively pursue violations.

### 2.1.4 U.S. Fish and Wildlife Service Fire Policy

By addressing the range of potential wildland fires and considering a full spectrum of tactical options (from monitoring to intensive management actions) for appropriate management response (AMR) to meet Fire Management Unit (FMU) objectives, this FMP meets Service wildland fire policy, and is consistent with Interagency Standards for Fire and Fire Aviation Operations and the Service Fire Management Handbook, which are supplemental policy.

This plan affirms these key elements of FWS fire policy (621 FW 1):

- Firefighter and public safety is the first priority of the wildland fire management program and all associated activities.
- Only trained and qualified leaders and agency administrators will be responsible for, and conduct, wildland fire management duties and operations.
- Trained and certified employees will participate in the wildland fire management program as the situation requires. Non-certified employees will provide support as necessary.
- Fire management planning, preparedness, wildfire and prescribed fire operations, other hazardous fuel operations, monitoring, and research will be conducted on an interagency basis with involvement by all partners to the extent practicable.
- The responsible agency administrator has coordinated, reviewed, and approved this FMP to ensure consistency with approved land management plans, values to be protected, and

natural and cultural resource management plans, and that it addresses public health issues related to smoke and air quality.

- Fire, as an ecological process, has been integrated into resource management plans and activities on a landscape scale, across agency boundaries, based upon the best available science.
- Wildland fire is used to meet identified resource management objectives and benefits when appropriate.
- Prescribed fire and other treatment types will be employed whenever they are the appropriate tool to reduce hazardous fuels and the associated risk of wildfire to human life, property, and cultural and natural resources and to manage Refuge lands for habitats as mandated by statute, treaty, and other authorities.
- Appropriate management response will consider firefighter and public safety, cost effectiveness, values to protect, and natural and cultural resource objectives.
- Staff members will work with local cooperators and the public to prevent unauthorized ignition of wildfires on Refuge lands.

#### 2.1.5 Refuge-specific Fire Management Policies

There is no fire management policy or direction specific to Prime Hook NWR.

### **2.2 Land/Resource Management Planning**

#### 2.2.1 Land and Resource Management Planning Documents.

Each Refuge is responsible for land management planning, including the process of setting goals and objectives for land use, implementing appropriate actions to accomplish the objectives, achieving outcomes and results, and evaluating the outcomes and results against the intended objectives. In the National Wildlife Refuge System, a Comprehensive Conservation Plan (CCP) is document that provides the over-arching land management plan. Prime Hook NWR is in the process of developing a CCP, expected to be finalized in 2009; the CCP and FMP are linked in addressing the public safety issues of nearby WUI communities through hazardous fuels reduction in pre-identified areas. Refuge Fire Management Objectives in this FMP are drawn from Refuge-specific enabling legislation, the Endangered Species Act, and the Refuge Improvement Act.

A Refuge Habitat Management Plan (HMP) steps down from a CCP to describe habitats and their biological characteristics needed to achieve the CCP's goals and objectives. HMPs describe management actions to restore and maintain habitats for the benefit of species of conservation concern. Annual habitat plans specify activities, treatment types and treatment areas. Because fire can be an effective ecological tool, there is strong linkage between an HMP and a FMP as related to use of prescribed fire alone or in combination with other treatment types to reduce hazardous fuels and maintain and improve habitats.

### 2.2.2 Compliance with Regulatory Acts

As required by the National Environmental Policy Act, the FWS has procedures to assess the environmental effects of specific Service actions. For actions not categorically excluded, an Environmental Assessment (EA), and, if necessary, an Environmental Impact Statement (EIS) must be prepared before making any land use decision, including fire management actions (516 DM 1-6). An EA that dealt exclusively with the Refuge fire management program was written in association with the 2002 FMP to support a decision to expand use of prescribed fire on the Refuge. An EA was completed in association with this 2009 FMP to propose and support a decision related to on-going treatments and treatment monitoring to reduce hazardous fuels (chiefly but not exclusively *Phragmites* stands) on Refuge lands near the WUI communities of Broadkill Beach, Prime Hook Beach, and Slaughter Beach. This FMP implements the selected alternative proposed in the 2009 Fire Management Program EA.

All FMP actions will comply with Section 106 of the National Historic Preservation Act and the Archeological Resources Protection Act.

The Refuge Fire Management program will be implemented in cooperation with the Endangered Species Act of 1973, as amended, and will take appropriate action to identify and protect from adverse effects any rare, threatened, or endangered species. Service policy requires that State threatened and endangered species and Federal candidate species will be incorporated into any planning activities. This consideration will be included in planning and implementing prescribed fires and hazardous fuel treatments.

Under the Clean Air Act of 1970 as amended (42 U.S.C. 7401 et seq.), the State of Delaware is required to develop and implement State Implementation Plans and Smoke Management Programs. Refuge personnel and Burn Bosses will coordinate prescribed fire project plans and ignitions with the Air Quality Management section of Delaware's Department of Natural Resources and Environmental Control to comply with all regulatory requirements and permits. More details are included in the Smoke Management section of Chapter 4.

### **2.3 Fire Management Partnerships**

A key aspect of successful fire management programs is cooperation with partners. The Refuge has limited initial attack capability, and the local Volunteer Fire Departments respond to emerging wildfires on the Refuge. Ensuring on-going communication, information sharing, and collaborative meetings, such as training and refinement of operating procedures is critical to maintain an effective fire management program.

Good communications aimed at keeping all affected and interested parties informed is also an important key to program success. Special communication efforts will be focused on adjacent landowners and local beach community residents.

Maintaining good working relations with the Delaware Department of Agriculture Forestry

Service and the Slaughter Beach and Milton Fire Departments will ensure the success of all the Refuge's fire management programs. In addition, consulting with the FWS Ecological Services staff in Chesapeake Bay Field Office on the Endangered Species Act, the Regional Historic Preservation Officer, and the State Historic Preservation Officers, may be necessary for certain activities. Consultation and coordination may also be necessary with the U.S. Army Corps of Engineers on Section 404 (Clean Water Act) compliance and Delaware's air quality regulatory offices.

### 2.3.1 Internal Partnerships

A partnership among Refuges in Delaware and Maryland provides agency funded staffing for wildland fire management services to those units. No one Refuge has a fire management workload sufficient to justify dedicated staff positions, but together they justify a Zone Fire Management Officer (FMO), associated fire support staff, and seasonal firefighters. The Zone FMO for Prime Hook NWR is based at Blackwater NWR in Maryland. Zone FMO duties are listed in Appendix C with those of the Regional office, Refuge Manager, and other staff.

### 2.3.2 External Partnerships

There are no federal land management agencies with lands in the vicinity of the Refuge to serve as suitable fire management partners. The U.S. Geological Survey, Water Resource Division has assisted with Geographic Information System (GIS) work related to *Phragmites* mapping and treatment monitoring of herbicide applications and prescribed burns.

The Refuge is within response areas of two fire departments, the Milton Fire Department, Inc. and the Memorial Volunteer Fire Department (Slaughter Beach). The Refuge has long-standing mutual aid agreements with these departments for wildfire suppression. These agreements need to be updated in the near future to better describe the authority and responsibility of the Fire Chief as Incident Commander on Refuge lands. Annual Operating Plans specify operational and administrative processes, which may provide for invoice and reimbursement of suppression costs. The Fire Directory in Appendix E should appear in any agreement with local fire departments or in the corresponding annual operating plan.

The refuge is a party to a Cooperative Fire Control Agreement with the Delaware Department of Agriculture, Forestry Unit.

To implement the Wildland-Urban Interface Initiative to protect over 750 homes in the three adjacent Beach communities, an informal partnership was established that included the Delaware Forest Service, USGS Dover Office, NASA – Wallops Island, the Milton and Slaughter Beach Volunteer Fire Departments, Prime Hook Volunteers, and 153 of 255 private landowners. It is expected that this partnership will continue to ensure maintenance of fuel reduction treatments.

As cost-share agreements are developed with these or other partners, they will be included either as sections within the above agreements or as separate documents, as appropriate.

### 3.0 Fire Management Unit Characteristics

A Fire Management Unit (FMU) is an area that shares common objectives, management constraints, physiological/biological/social characteristics and constraints, that result in desired conditions as stated in land management plans which set it apart from the characteristics of an adjacent FMU.

In consideration of the above criteria, the Refuge will be managed as one FMU. The entire unit is managed for wildlife use, except for small areas for administrative and visitor use. In view of fire occurrence, the wildland fire program complexity at Prime Hook NWR is moderate.

#### 3.1 FMU-Wide Management Considerations

##### 3.1.1 Fire Management Direction from Refuge Comprehensive Conservation Plan.

Habitat and public use goals and objectives developed for the Refuge's CCP and HMP provide the framework and details as to what and how the Refuge will focus management actions on to conserve, protect, enhance and/or restore healthy communities of native plants, fish, and wildlife, provide wildlife-based recreation, and protect public safety. These management goals, strategies and prescriptions are explicitly linked from the CCP, HMP, the Delaware Wildlife Action Plan, and other regional and national plans to this FMP. Specific Refuge management goals are:

**Goal 1: *Barrier Beach Island and Coastal Salt Marsh Habitats.*** Manage, enhance, and protect the dynamic barrier beach island ecosystem for migratory birds, breeding shorebirds and other marine fauna and flora. Perpetuate the biological integrity, diversity and environmental health of *Spartina* low and high salt marsh habitats.

**Goal 2: *Forested Habitats.*** Perpetuate the biological diversity, integrity, and environmental health of Refuge upland and wetland forested cover-types to sustain high quality habitats for migratory birds, increase quality habitat for the endangered Delmarva fox squirrel (DFS), breeding and wintering landbirds, reptiles, amphibians and other resident wildlife.

**Goal 3: *Refuge Impounded Marsh Complex.*** Maintain, create, and enhance 5,000 acres of freshwater and brackish wetland habitats within and surrounding the Refuge's Impoundment Complex for migrating shorebirds, breeding rails, wading birds, American Black Ducks and migrating and wintering waterfowl. Support obligate amphibians and other native wetland-dependent species, provide fish passage and nursery habitats for anadromous fish species, protect and conserve rare native flora and fauna dependent on Refuge managed hydrology.

**Goal 4: *Early Successional Upland Habitats.*** Maintain, enhance, and/or restore the native vegetation, biological diversity and ecological integrity of early successional upland habitats to create an assorted mosaic of grassland and/or herbaceous scrub/shrub habitats mixed with transitional forested areas to conserve migratory birds, breeding landbirds, endangered species, and to maximize benefits for other priority resources of concern.

**Goal 5: *Public Use.*** Ensure visitors of all abilities can enjoy wildlife-dependent recreation,

appreciate the Refuge's cultural and natural resources, and increase their understanding of and support for the Refuge's purposes.

**Goal 6: *Partnerships.*** Collaborate with the local community and partners to complement habitat and visitor services programs on the Refuge and the surrounding landscape.

**Goal 7: *Safety.*** Ensure the safety of the public, firefighters, and all employees and neighbors associated with the Refuge from wildland fire and its impacts by regularly assessing risk and reducing hazardous fuel loads in and near wildland-urban interface areas in a cost-effective manner using various treatments as appropriate.

The following Refuge operational objectives are derived from Prime Hook NWR enabling legislation, national legislation, and Refuge purposes:

- Provide resting habitat and food resources for migratory birds, especially migrating and wintering waterfowl, shorebirds, marsh and wading birds.
- Preserve, restore, and enhance in their natural ecosystems, species of animals and plants that are state or federally endangered or threatened, or of special conservation concern.
- Manage forested, shrubland, and grassland habitats for other nesting and migrating species of waterfowl, shorebirds, Neotropical land birds, breeding forest interior, shrubland and grassland birds, and native resident wildlife.
- Provide hunting, fishing, wildlife observation and photography, and environmental education and interpretation opportunities for Refuge visitors as priority uses.
- Identify hazardous fuels treatment areas near identified WUI Communities at Risk and other communities and homes along the Refuge boundary. Adopt a long-term strategy to reduce fuel loads using appropriate treatments of various types. Collaborate with state and local partners in projects that will increase defensible space or implement FIREWISE or FIRESAFE techniques within the communities themselves.

### 3.1.2 Fire Management Direction from Step-down Plans and Other Sources.

Appropriate Management Response (AMR) will follow appropriate Department and Service policy and direction. These current standards (095 FW 3) are pertinent:

- An initial action and an appropriate management response is required for every wildfire on or threatening our lands.
- The range of appropriate management responses to wildfires may include direct or indirect attack of high and/or low intensities, or surveillance and monitoring to ensure fire spread will be limited to a designated area.
- Surveillance is an appropriate management response to a wildfire if so designated in an approved FMP or selected through an approved analysis process (such as the Wildland Fire Decision Support System or a Wildland Fire Situation Analysis).

Maximizing the cost effectiveness of any fire operation is the responsibility of all involved, including those who authorize, direct, or implement operations. Cost effectiveness is the most economical use of resources necessary to accomplish project/incident objectives. Accomplishing the objectives safely and efficiently will not be sacrificed for the sole purpose of “cost-saving.” Appropriate oversight will ensure that expenditures are commensurate with values to be protected. Other factors besides those in the biophysical environment may influence decisions, including those from the social, political, and economic realms (FWS Fire Management Handbook).

#### General Fire Management Goals:

- Protect human life, public safety, resources, and public and private property.
- Prevent human-caused wildfires.
- Manage wildfires using AMR strategies and tactics that consider firefighter safety, values to protect, and costs and impacts of proposed actions. When safe, minimize fire size.
- Reduce hazardous fuels near WUI areas using combinations of treatment types.
- Restore fire as a natural ecological process in Refuge habitats when and where possible to reduce and maintain fuels at non-hazardous levels and to enhance and maintain habitats.
- Protect habitat for endangered, threatened, and species of concern.
- Protect cultural/historic resources.
- Educate the public regarding the role of fire within the Refuge.

The following considerations were used to develop the Prime Hook NWR fire management goals and objectives, as outlined by Refuge mandates and Refuge system organic legislation:

- Fire is an essential tool for maintaining the Refuge’s native biotic communities.
- Uncontrolled wildfire has the potential for negative impacts.
- Prescribed fire has positive effects on vegetation and wildlife, when appropriate techniques are applied during favorable conditions.
- Use of appropriate minimum impact suppression tactics can minimize resource damage.

## 3.2 Prime Hook Fire Management Unit

### 3.2.1 Prime Hook FMU Description

#### 3.2.1.1 Wildland Fire History

Various fire types, including naturally-occurring (lightning) fires and those associated with activities of Native Americans and European colonists have historically influenced vegetation in the eastern United States (Patterson and Sassman 1988). Brush (1986) found evidence of fire in the Delmarva between 1000 and 1200 A.D. Kirwan and Shugart (2000) found charcoal evidence of historic fires in Delmarva forests, especially those with scarlet oak (*Quercus coccinea*).

Fire historically influenced habitats in the mid-Atlantic including its Coastal Plain. Frost (1998) estimated fire frequency in coastal Delaware prior to European colonization at 7 - 12 years.

Sussex County was first settled by the Swedish in the 1600s. Settlers practiced large-scale farming and used fire to sustain hunting and trapping, to enrich forage for domestic animals, and for slash-and-burn agriculture. From the late 1800s until the Refuge was established, Refuge wetland and upland habitats were frequently burned in low-intensity fires, often each spring, to prevent encroachment of scrub-brush vegetation and red cedars, to improve cattle grazing and haying in salt marsh areas and to maintain a neat appearing landscape. Annual marsh burning, heavy grazing, and harvesting excluded large fires during this period. An occasional small fire was ignited by upland game hunters to "smoke out" prey and local trappers burned freshwater marshes at the end of each season to improve muskrat habitat and to facilitate access to trap lines.

From the 1970s until the early 1980s, the common reed *Phragmites australis* dominated Refuge marshes. Wildfires were easily caused by human carelessness and arson.

Notable historic fires are recorded in annual refuge reports. On January 13 and 14, 1969 an arson fire near Prime Hook Beach Road burned over 1,500 acres of marsh and threatened both Prime Hook Beach and Broadkill Beach communities. On April 17, 1977, a fire of undetermined origin, fueled by *Phragmites*, burned 1,100 acres near the Prime Hook Beach community and threatened homes adjacent to this portion of the marsh for three days. Over 200 firefighters from eight fire departments, the Lewes Naval Facility, Delaware Forest Service and the Delaware State Police were involved. In November 1985, an arson fire burned 960 acres of *Phragmites*, endangering homes in Prime Hook Beach.

From 1980 to 2008, there are records of thirty one wildfires that burned 3,200 acres. None of these fires were caused by lightning. Nearly half of them (14) occurred in March. One burned 1250 acres (below). Records indicate most wildfire causes as incendiary, debris burning, or discarded cigarettes. Wildfires have typically originated in grass near public roads, Refuge boundaries, or other areas with good access.

On March 10, 2002, a human-caused wildfire of undetermined origin burned 1250 acres near the Slaughter Beach community. There had been no precipitation for six days prior to the ignition.



On that date, the Refuge weather station recorded relative humidity readings of 30% or less from 9 AM to 9 PM, with a low of 18%, and wind speed readings exceeding 20 mph for 8 hours, with a peak of nearly 30 mph. The fire in the marsh spread at rates over 100 feet per minute and with flame lengths over 20 feet. More than thirty fire apparatus responded, from as far away as Denton, Maryland, to protect structures in Slaughter Beach and Prime Hook Beach communities and to control the fire along Fowler Beach Road. A backfire held the fire along a canal; a State Forestry tractor plow built line on the western flank, according to the Refuge Operations Specialist. After 9 PM, relative humidity increased, the winds died and fire spread stopped.

During the 1980s, the Refuge used prescribed fire to reduce hazardous accumulations of *Phragmites* and woody fuels. Fire was also used in woodlands to improve understory conditions for the Delmarva Peninsula Fox Squirrel, create more diverse plant communities and increase oak recruitment. Between 1985 and 2008 there have been 17 prescribed fires that treated 2,321 acres and one mechanical project that treated 28 acres. In identified WUI areas, there have been four chemical treatments for 10,100 acres, 7 prescribed fires that treated 2,918 acres, two mechanical treatments for 80 acres, and one reported as other for 54 acres. The sum of treatments reported since 1985 is approximately 15, 500 acres.

#### 3.2.1.2 Water, Topography and Soils

The Refuge is flat and mostly below ten feet mean sea level. The uplands are gently sloped; steep grades are found only adjacent to drainages. As a result, the water table is at or near the surface for long periods of the year. The Refuge includes almost 8,000 acres of marsh, open water, small creeks and impoundments; 4,500 acres of impounded marsh is fresh to moderately brackish, yet the vegetation is often climax or near climax salt marsh along the impoundment peripheries.

The normal daily tidal range of Delaware Bay is 12 to 26 inches. Normally there is minimal salt water inundation of the Refuge marshes. During extreme tides and storm surges which occur several times annually, tides typically top roads, dunes, and dikes to inundate the marsh. The fluctuations in annual salinity that accompany these tidal variations affect nearly all Refuge habitats. Salt intrusions may allow halophytes to become established in certain low areas where they out-compete less salt-tolerant and/or more desirable vegetation.

Tidal marsh soils are low-lying and regularly flooded with either fresh or salt water. They are composed mostly of peat or muck remains of vegetation, but include loamy soil materials. The soils range from strongly saline to brackish or almost fresh depending on annual water regime. Upland Sassafras soils are well to poorly drained, with moderately permeable subsoil of sandy loam to sandy clay loam. Upland Fallsington soils are moderately permeable and poorly drained, with a surface gray to dark grayish-brown sandy loam or loam layer and a subsoil of gray to light gray heavy sandy loam to sandy clay.

#### 3.2.1.3 Climate

The climate is temperate and humid, with cool winters and warm summers. Monthly mean low temperatures are below freezing only in January and February; the coldest period typically lasts a

maximum of 2-4 weeks. Summers are hot and humid, with monthly mean high temperatures (Fahrenheit) in the 80's, with occasional 90 degree days that can occur from April to October. The maximum recorded high temperature exceeded 101 degrees. Snowfall is extremely variable and may be non-existent or as much as 15 inches in one day. Median annual precipitation is just over 44 inches, usually well distributed throughout the year. (2000 NOAA Climatology Report, Lewes, Delaware.)

Hazardous weather includes lightning, hurricanes, Nor'easters, and cold front passages. Some lightning typically occurs in late spring and summer, usually accompanied by wet thunderstorms. Occasionally hurricanes track over the area from late August to October 1. Nor'easters occur from November through March; the high tides and strong winds of these storms often result in flooding of salt water into freshwater impoundments and some upland areas, with heavy erosion of Refuge dikes.

Cold front passages of most concern for fire managers occur in the late winter and early spring, when fuels are cured, there is little ice in the marshes, and associated humidities are low.

#### 3.2.1.4 Habitats

Refuge habitats include freshwater and brackish impoundments, inter-dunal wetlands, *Spartina* high and low salt marsh, barrier beach island habitats, Red Maple and Seaside Alder/Atlantic White Cedar swamps, mixed hardwood forested areas, early successional upland habitats and ancient sand ridge Maritime forests (See HMP for habitat description details). These cover types provide habitat for 308 species of birds, 51 species of fish, 5 species of shellfish, 45 species of herptiles, 37 species of mammals, hundreds of rare plant species and dozens of rare amphibians and insects. (See CCP for a comprehensive list of wildlife species and HMP for list of native, alien, and rare plant species found on the Refuge.)

The numbers of waterfowl using the Refuge peak from early October until Christmas; as many as 85,000 ducks and 159,000 geese have been recorded during a single aerial survey. During late April and May (spring migration) and again from mid-July through September (fall migration) significant numbers of shorebirds use the Refuge's impoundments. Neo-tropical landbirds migrate through and utilize the Refuge's forested, scrub/brush and grassland habitats during both spring and fall migrations. These cover-types also provide important breeding habitats for a variety of landbirds which are of State, regional, and national management concern. These include resident songbirds such as chickadees, and nuthatches and short and long distance Neotropical migrants such as tanagers, flycatchers, sparrows, wrens, thrushes, vireos, and warblers.

**Emergent Wetlands** are vegetated by erect, rooted herbaceous species that tolerate a wide range of salinity and flooding, and which are present for most of the growing season; i.e. saltmarsh cordgrass (*Spartina spp.*), needlerush (*Juncus gerardi*), saltgrass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), common reed (*Phragmites australis*), cattails (*Typha spp.*), bulrushes (*Scirpus spp.*), sedges (*Carex spp.*), waterdock (*Rumex spp.*), rose mallow (*Hibiscus palustris*), rice cutgrass (*Leersia oryzoides*), Chufa (*Cyperus esculentus*), beggarticks (*Bidens spp.*), Walter's millet (*Echinochloa walteri*), smartweeds (*Polygonum spp.*), wild rice (*Zizania aquatica*), fall

panicum (*Panicum dichotomiflorum*), arrow arum (*Peltandra virginica*), pickerelweed (*Pontedaria cordata*), and arrowheads (*Sagittaria spp.*).

**Aquatic Beds** are seasonally flooded, shallow habitats dominated by diverse plant communities that grow mostly on or below the water surface - either attached to the substrate or freely floating. Dominant species include white water lily (*Nymphaea odorata*), yellow cow-lily (*Nuphar luteum*), coontails (*Ceratophyllum sp.*), water milfoil (*Myriophyllum sp.*), pondweeds (*Potamogeton spp.*), widgeon grass (*Ruppia maritima*), water shield (*Brasenia schreberi*), smartweeds (*Polygonum sp.*), and duckweeds (*Lemna spp.*). *Hydrilla verticillata* has invaded where public fishing and boat access is heavy.

**Scrub-Shrub Wetlands** are a seral stage leading to forested wetlands, dominated by woody vegetation less than 6 meters tall. In estuarine areas, vegetation includes groundsel bush (*Baccharis halimifolia*), red cedar (*Juniperus virginiana*), marsh elder (*Iva frutescens*) and bayberry (*Myrica pennsylvanica*). In palustrine areas, vegetation includes buttonbush (*Cephalanthus occidentalis*), seaside alder (*Alnus maritima*), Atlantic white cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*).

**Forested Wetlands** are characterized by woody vegetation over 20 feet (6 meters) tall. They occur in all water regimes except the sub-tidal. Dominant trees are red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), tupelo gum (*Nyssa aquatica*), swamp white oak (*Quercus bicolor*), and Atlantic white cedar (*Chamaecyparis thyoides*). A loblolly pine/hardwoods mix may also occur, where loblolly (*Pinus taeda*) is 20 % or less of the stand

**Agricultural Lands** are the remnant of approximately 950 acres that were cooperatively farmed from the 1970s to the mid-1990s. In 2006 only 400 acres of land continued to be cooperatively farmed. The remainder has reverted to native forest, shrubland and/or grassland communities, or as early successional "old fields."

**Deciduous Forest** typically occurs along the edge of fields and marshes or small wooded islands. The forest has two main associations. The most common is the mixed hardwood/loblolly pine stands where loblolly (*Pinus taeda*) is less than 20% of the stand. Its site compositions are:

- On moist or wet coastal sites: sweetbay (*Magnolia virginiana*), swamp tupelo (*Nyssa aquatica*), and red maple
- On inland wet sites: sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*) and red maple
- On upland and drier sites: southern red oak (*Quercus falcata*), white oak (*Quercus alba*), hickory (*Carya spp.*) and blackgum

The second most common association is sweetgum. Its site compositions are:

- On well drained sites: Virginia pine (*Pinus virginia*), hickory (*Carya spp.*), sassafras (*Sassafras albidum*), and persimmon (*Diospyros virginiana*)
- On moderately to poorly drained sites: red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), willow oak (*Quercus phellos*), and yellow-poplar (*Liriodendron tulipifera*)

**Coniferous Forest** is dominated by loblolly pine and eastern red cedar (*Juniperous virginiana*).

**Deciduous shrublands** are typically forest lands cleared in late 1800s and early 1900s for agriculture, now in transition back to forest. Predominant species are groundsel bush (*Baccharis halimifolia*), high tide bush (*Iva frutescens*), southern bayberry (*Morella cerifera*), and Northern bayberry (*Morella pennsylvanica*). Other deciduous shrubs include seaside alder (S-3) (*Alnus maritima*), smooth alder (*A. serrulata*), shadbush (*Amelanchier canadensis*), red chokeberry (*Aronia arbutifolia*), buttonbush (*Cephalanthus radicans*), sweet pepperbush (*Clethra alnifolia*), black hackberry (*Gaylussacia baccata*), dangle-berry (*G. frondosa*), winterberry (*Ilex verticillata*), swamp azalea (*Rhododendron viscosum*), winged sumac (*Rhus copallinum*), common elderberry (*Sambucus canadensis*), and low and high bush blueberry (*Vaccinium corymbosum* & *V. pallidum*).

**Grassland** is vegetated by numerous species, the most predominant of which is the endemic switch grass (*Panicum virgatum*), which can reach 3 feet tall. Other native perennial and annual grasses include broom-sedge (*Andropogon virginicus*), bushy bluestem (*A. glomeratus*), rare bushy bluestem (S-1) (*A. g. var hirsutor*), silver bluestem (*A. ternarius*), poverty oatgrass (*Danthonia spicata*), deer-tongue grass (*Dichanthelium clandestinum*), purple top (*Tridens flavus*), panic grass (*Panicum rigidulum*), and warty panic grass (*P. verrucosum*).

### 3.2.1.5 Fuels and Fire Behavior

The habitats listed in Table 1 equal the total Refuge size of 10,132 acres. 9,462 acres are considered burnable (93% of the total). A fuel model and values for fire behavior characteristics are associated with each habitat. Flame length and rate of spread values are based on modeled conditions likely (not worst case) during a cold front passage before spring green-up, conditions similar to those recorded during the March 2002 Slaughter Beach fire.

Table 1. Refuge Habitats and Acres, Fuel Types, and Fire Behavior Characteristics

Habitats	Acres	Fuel Model	Flame Length	Rate of Spread
<i>Wetland Habitats</i> 8,409 (82% of total)				
Emergent Marsh	5,367	Tall Grass	>19 feet	257 feet/minute
Marsh Easements	827	Tall Grass	>19 feet	257 feet/minute
Aquatic beds	670	non-burnable	0	0
Scrub/shrub	688	Brush	8.6 feet	75 feet/minute
Forest wetlands	772	Leaf Litter	3.6 feet	14 feet/minute
Sandy Beach	85			
<i>Upland Habitats</i> 1,723 (18% of total)				
Agricultural	650	Short Grass	7.3 feet	280 feet/minute
Deciduous forest	767	Leaf Litter	3.6 feet	14 feet/minute
Coniferous forest	104	Leaf Litter	3.6 feet	14 feet/minute
Deciduous shrub	48	Brush	8.6 feet	75 feet/minute
Grassland	154	Short Grass	7.3 feet	280 feet/minute

Specific input values used are 5% fine fuel moisture content, 20 mph surface (20 foot) wind

speed, and 0% slope, with models 1 and 3 fully exposed to wind. The table values will increase if surface winds exceed 20 mph or fine fuel moisture drops below 5% and decrease if fuels are patchy. The values above are useful estimates for planning purposes only. Four foot flame lengths are considered the limit for successful direct attack by firefighters with hand tools, and eight foot flame lengths the limit of the control for engines with water streams. The typical worst case can cause significant control problems in continuous marsh fuels and present challenges to firefighters in the other fuel types without the support of water streams or use of advantageous positions such as roads and streams, fuel clearings near structures, etc. Fuel type descriptors and calculated fire behavior characteristics are based on concepts and techniques in Rothermel (1983).

*Short Grass (Grasslands and scrublands where grass carries fire)—Fuel Model 1*

Surface fires ignite and spread easily through fine, continuous cured grass up to a foot tall. Fire characteristics are directly related to fuel moisture and wind speed. Spotting is generally not a problem, because fuel is burned quickly and thoroughly. Resistance to control is low to moderate, depending on wind speed. The flaming front is usually not very deep.

*Tall Grass (Marsh, approximates Phragmites) —Fuel Model 3*

Fires can burn intensely through standing cured or dead vegetation that is three feet tall or more. Wind may drive fire across standing water in the tips of vegetation. Fire behavior characteristics are directly related to fuel moisture and wind speed. Flame lengths and short range spotting (to 100 feet) pose serious problems for firefighters. Fires in this fuel type present safety issues to firefighters because of the fire intensity (flame lengths), the depth of the flaming front, and the difficulty of maneuvering in the vegetation.

*Brush 2 to 4 feet High (Shrub/scrublands where brush litter carries fire)—Fuel Model 6*

Vegetation consists of understory grasses and forbs, and litter cast by shrubs. A broad range of shrub conditions may be covered. Live fuels are usually absent, sparse, or have high fuel moisture content, so they don't affect fire behavior. Often wind speeds of 20 mph are needed to carry fire. Fire will drop to the ground at low wind speeds or openings in the stand. Fires in dense, shorter brush growing in wetlands could present challenges during droughts.

*Compact Leaf Litter (Wetland/ upland forests) —Fuel Model 8*

The vegetation is mainly deciduous woodlands with closed to semi-closed canopies. The litter layer is compact, composed of leaves and twigs, and has little undergrowth. Slow-spreading surface fire can generally be expected with low to moderate flame lengths, except when occasional fuel concentrations burn. Fires will normally remain on the surface, except under dry conditions when fire may burn down through the duff layer and into underlying peat. Only in severe conditions with high temperature, low relative humidity, and high winds do these fuels pose significant fire hazards.

*Loosely Compacted Leaf or Needle Litter (Upland forests) —Fuel Model 9*

The vegetation is open or closed deciduous stands and mixed stands during leaf-off, otherwise similar to fuel model 8. Fires will generally remain on the surface. The litter layer is fluffy and leaves are subject to movement under windy conditions. Scattered concentrations of dead or downed woody material are greater than in Fuel Model 8. Fires will spread faster than those in

fuel model 8 but still will move slowly through dead, loosely compacted leaf litter and understory grasses. Fire behavior is directly related to fuel moisture, fuel loading, and wind speed in and near canopy openings. Wind-blown leaves and fire that torches into trees may cause short-range spot fires that increase rate of spread above predicted values. Resistance to control is usually low to moderate, but control and mop-up can be difficult during drought and/or windy conditions.

### 3.2.2 Prime Hook FMU Values to Protect

#### 3.2.2.1 WUI Communities: Slaughter Beach, Prime Hook Beach, and Broadkill Beach

These communities lie near the Refuge's east boundary, along the west shore of Delaware Bay, and together contain over 750 homes, with median values of \$250,000 to \$300,000. Over 60% of the homes are occupied year-round; the rest are used seasonally, usually from April to November.

There are many homes immediately adjacent to Refuge marshes that can be affected by Refuge marsh fires. Marsh fires in *Phragmites* may spot up to 1,000 feet, potentially putting many of the homes at risk. Cold front passages with NW strong winds in late fall and early spring (when fuels can readily ignite and burn) will push fires toward the communities, as has occurred in the past.

Over 4,000 acres in the nearby marsh were treated to reduce fuels in the past five years. The placement of the treatment units is intended to reduce the potential for air-borne embers from a wildfire to land in the communities. While most homes have composition roofs, some are cedar shakes or shingles. If fire were to ignite one roof, it could very quickly build up intensity, spot, and involve multiple structures. Many homes have wood siding and attached wood decks which make them vulnerable to spot fires. In addition, some homes are built on pilings with flammable vegetation underneath, which creates a fire hazard. Other homes and structures have flammable vegetation nearby without adequate clearing.

Each community extends about one mile north and south along the Bay along narrow, unpaved lanes with homes on small lots. Each community has a single access route. The narrow lanes could easily be clogged by fire apparatus, restricting evacuation. Smoke could impact traffic safety during evacuations. Nearby beaches offer safety zones for firefighters, residents, and tourists.

The relative isolation of the communities can allow for undetected arson, as has been experienced in the past. Lack of defensible space, lack of fire hydrants, and narrow access lanes in the communities are serious challenges to the fire departments in attempting to safely control emerging fires. Water can be pumped from canals or dry wells to water tenders/engines.

**Slaughter Beach** lies at the end of the paved Slaughter Beach Road. It has its own volunteer Fire Department. Mechanical fuel reduction has historically been performed between the northern-most structures and the Refuge boundary by thinning and limbing up trees, and mowing grass, with limited use of prescribed fire due to the proximity to the homes.

**Prime Hook Beach and Broadkill Beach** are accessed by the paved Prime Hook Beach Road or State Route 16 (Broadkill). Mowing has removed *Phragmites* immediately adjacent to private lands. Additional treatments have significantly reduced fuels in the marshes to the west. These communities are in the response area of the Milton Volunteer Fire Department, so a response to an emerging incident may be delayed by travel time to the area.

#### 3.2.2.2 Other WUI Areas

This sub-section is not intended to be all inclusive, but rather to suggest other areas needing attention. Some elements of the above scenarios apply to these areas. However, issues of congestion and multiple structure involvement, lack of access and water, and the isolation of the area are lessened. Furthermore, except in rare events, these areas are not well-aligned with the winds associated with a cold front passage. This is not to suggest that an uncontrolled fire with relatively short flame lengths could not burn structures and threaten human life if there is no break in continuous fuels nearby.

The Refuge headquarters area at the end of Turkle Pond Road contains government-owned offices, maintenance and storage buildings, visitor facilities, walking and canoes trails. Although the maintenance areas have narrow access, in general, exposure to risk is mitigated by the wide roads, parking lots, and defensible space; there are many barriers to fire spread such as ponds and open fields, and good access to responding fire departments.

Private lands near the western edge of the marsh between Fowler Beach road and Prime Hook Beach road contain a residence and outbuildings within upland forest and dense brush, with narrow, limited access and lack of defensible space and water sources.

Privately-owned crop lands along the north, northwest, and west boundaries, with scattered homes and outbuilding among them.

Boundary areas along Turkle Pond Road from Highway one east past the golf course include scattered homes and outbuildings along the Refuge's western boundary, mostly adjacent to woodlands or small marshlands.

#### 3.2.2.3 Threatened and Endangered Species and Special Concern Habitats

The Delmarva Peninsula fox squirrel is the only resident federally endangered species known to occur on the Refuge. The Piping Plover (which is being considered for State listing at the time of this writing) uses Refuge habitats in the spring, late summer, and fall. The Refuge also supports many state endangered species and several key wildlife habitats of special conservation concern. State endangered species include the bald eagle, short-ear owl, northern harrier, Cooper's hawk, black-crowned night heron, pied-billed grebe, American oystercatcher, black rail, sedge wren, common tern, Forster's tern, least tern, black skimmer, Northern parula, hooded warbler, and red-headed woodpecker.

Key wildlife habitats of special concern that are State and globally rare and also designated Refuge priority habitats in the CCP/HMP include dune grassland, maritime red cedar woodland, mixed hardwood blocks greater than 250 acres in size, Atlantic white cedar/seaside alder swamp, coastal plain depression ponds, twig-rush peat bog community, and early successional grassland and shrubland communities (See HMP for more detailed NVCS community descriptions).

Southern red oak/heath forest, mesic coastal plain oak forest, mid-Atlantic mesic mixed hardwood, and Northern Coastal Plain basic mesic hardwood stands are NVCS communities on the Refuge. Periodic fire is an important natural disturbance for these communities to encourage oak regeneration and enrich herbaceous diversity. Atlantic white cedar/seaside alder habitats also require fire to regenerate and expand stand acreage. Periodic prescribed burns can help make this community more robust but adequate precautions must be taken to protect rare amphibians and other unique fauna.

The Delmarva fox squirrel mixed hardwood forest habitats, coastal plain depression habitats (isolated non-tidal freshwater wetlands within forested areas), isolated peat bog and other exemplary rare plant communities, and early successional shrubland and grassland habitats all benefit from periodic disturbance, such as fire, to set back woody succession, open up forest-under stories, and enhance food and cover requirements for targeted resources of concern. Such actions will require planning and consultation with state and federal endangered species habitat specialists and regional biologists to ensure that fire treatments are compatible with life cycle requirements of listed plant and animal species.

Sensitive areas of exemplary rare native plant communities and their association with a diversity of State rare (S1-S3 ranked) amphibians, reptiles, dragonflies and damselflies (*Odonata*), fireflies (*Coleoptera:Lampyridae*), tiger beetles (*Coleoptera:Carabidae*), moths and butterflies (*Lepidoptera*) and wasp species (Hymenoptera) have been documented (See HMP for specific details, species lists and habitat requirements of state rare species).

#### 3.2.2.4 Cultural Resources

Three sites discovered in 1980 are eligible for inclusion in the National Register of Historic Places: the historic component of the old Morris residence (located in the headquarters area), a Teacup Island site with shell midden artifacts and preserved organic debris, and an Oak Island site with thick aboriginal ceramic shards.

Recent (2004) archeological studies identified and mapped fourteen prehistoric archeological sites and 31 historic archeological sites, finding evidence that people have occupied the coastal areas of the Refuge for more than 9,000 years. (Tetra Tech final report, "Archeological, historical and geomorphological study of Prime Hook National Wildlife Refuge, Sussex County, Delaware.") More extensive information is in Chapter 3 of the Refuge CCP.



### 3.2.3 Prime Hook FMU Wildfire Management Guidance

#### 3.2.3.1 Guidance to Incident Commanders for Wildfire Response

- All unplanned ignitions are wildfires to be contained and controlled by an AMR using a well-established mutual aid program. No fires will be managed for wildland fire use.
- Suppression of wildfires is an appropriate management response in areas where fire puts public safety, critical infrastructure, and irreplaceable resources at risk.
- Wildfires will be staffed or monitored during active burning periods as needed to ensure that appropriate mitigation actions can be made to protect values threatened.
- All resources, including mutual aid, will report to the IC in person or by radio and receive an assignment prior to deployment on a fire.
- Evaluation and selection of an appropriate management response to a wildfire will include consideration of risks to public and firefighter safety, threats to the values to protect, the costs of various suppression/mitigation strategies, and any potential resource benefits.
- All wildfires will be supervised by a qualified Incident Commander (IC) who through the Delegation of Authority (Appendix J) is responsible for the following:
  - Assess the fire situation and make a report to dispatch as soon as possible.
  - Use guidance in this FMP and/or a delegation of authority to determine and implement an appropriate management response.
  - Determine organization, resource needs, strategy and tactics.
  - Brief incoming and assigned resources on the organization, strategy and tactics, weather and fire behavior, LCES, and radio frequencies.
  - Order resources needed for the AMR through the designated dispatch office.
  - Manage the incident until relieved or the fire is controlled.
- ICs may need assistance from Refuge Resource Advisors to assess impacts of the fire and AMR actions on state and federally-listed endangered, threatened, and special concern species and their habitats and on cultural resources.
  - Early involvement of the Refuge Biologist or the State Historic Preservation Officer may help mitigate impacts, especially for fires exceeding initial attack.

#### 3.2.3.2 Limitations and Constraints on Incident Commanders and Wildfire Response

This FMP and a delegation of authority provide a general strategy to an IC, who has discretion to select and implement tactics within the limits and constraints described below, including when and where to use minimum impact suppression tactics (MIST) to minimize any negative impacts of suppression actions as much as possible. This means using fewer ground-disturbing tactics and minimizing the use of retardants and foams, but it also means applying alternative strategies and

tactics that are effective in accomplishing the incident objectives.

### **Obtain Permission for Use of Heavy Equipment, Retardant, and Foam**

- Use of crawlers, tractors, dozers, graders, etc. off roadways requires approval from the Refuge Manager or designate except when use is critical to public life safety or to prevent a fire from destroying private and/or government structures and historic resources.
- No use of aerial retardant or foam within 300 feet of waterways, canals, marsh, etc. Use elsewhere on the Refuge permitted only with approval of the Project Leader.

### **Minimize Impact**

- Maximize use of natural/artificial barriers like roads, ditches, canals, or impoundments.
- Construct fire line only as needed to accomplish the AMR.
  - Include 100 foot (30m) buffer strips between constructed line and waterways.
  - Orient fireline needed in the buffer of undisturbed vegetation perpendicular to the water, if practicable.
  - Avoid use of heavy equipment, fire retardant, and foam in the buffer strip.
- Repair and stabilize resources and facilities disturbed by AMR activities promptly.

### 3.2.4 Prime Hook FMU Fuels Treatment Guidance

#### 3.2.4.1 WUI Treatment Program

Herbicide treatments, mechanical mowing, and prescribed fire will be used to reduce standing dead canes of *Phragmites*, remove the debris from the site, and allow natural re-emergence of native grasses. Primary and Secondary Treatment Zones are identified on a map in Appendix A. [Note that the terms above are not included in the legend for the WUI Treatment Map (Map A4). The map was designed for the WUI treatments completed in 2004. Polygons delineated by color and diagonal striping as Zero Tolerance are the Primary Treatment Zones identified in this FMP and those delineated as Limited Tolerance are the Secondary Treatment Zones.]

Treatment objectives are as follows:

- For Primary Treatment Zones, remove 100% *Phragmites* fuels (live and dead) within a 1,000 foot buffer zone west of each of the 3 beach communities adjacent to the Refuge and along respective access roads. Treatment needs will be evaluated annually. **Up to 150 acres will be effectively treated annually** in various treatment blocks as needed, using herbicide, mechanical treatment and/or prescribed fire.
- For Secondary Treatment Zones, reduce and/or eliminate *Phragmites* cover, height, density and litter depths (fuel loads) within the sampled population. Treatment needs will be evaluated by periodic assessment of transect data. **Up to 1,000 acres will be effectively treated within a three year period** in various treatment blocks as needed, using herbicide, mechanical treatment, and prescribed fire.

### 3.2.4.2 Non-WUI Treatment Program

Prescribed burning is a useful habitat management tool for wildlife and public safety, including:

- improving Delmarva Fox Squirrel habitat
- thinning overstocked forest stands and improving forest health
- increasing forage plant production for migratory waterfowl
- clearing dead vegetation and preparing seed beds
- changing hydrologic processes
- improving and maintaining early successional grasslands and shrublands for breeding and migrating landbirds of conservation concern.

Project objectives for hazardous fuel reduction should incorporate and complement habitat management objectives, and vice-versa. Over-all objectives include:

- In all habitats, reduce and maintain fuel loads within normal range of variability to protect Refuge resources and private property from effects of abnormally severe wildfires.
- In marshes, increase habitat patchiness to provide wetland-dependent species with more diverse vegetation and provide opportunities for more optimal feed and cover conditions.
- In forests, remove vegetation to improve and maintain open understory in order to enhance food and cover for the Delmarva Fox Squirrel, and augment mast production.
- In grasslands, help maintain and enhance habitat for Henslow sparrows and other grassland-dependent resources of concern targeted for special conservation attention.
- In uplands, help meet habitat objectives to create and maintain mosaics of transitional, young, and old shrubland patches for early successional shrubland-dependent bird species.

### **Treatment Goals**

- Mow 400 acres of fallow “old” fields periodically each year to keep fuels under 2 feet tall.
- Treat up to 500 acres of upland habitat over a 10 year period to provide for expansion of Delmarva fox squirrel habitat, in combination with other measures.

Refuge-specific limitations on prescribed fire use include a small Refuge staff with limited qualifications and experience, narrow burn windows, close proximity of highways and WUI areas, regulatory and public safety concerns regarding smoke management, and the need to protect sensitive habitat(s) and nesting birds. The limited range of prescribed fire intensity (to maintain control) may limit its ability to create vegetative mosaics.

Key wildlife habitats and Refuge priority resources of concern that would benefit from prescribed fire are listed in the table below:

Table 2. Priority Resources of Concern for Prime Hook NWR

Priority Type I Habitats	Associated Priority Species
<b>Barrier Beach Islands:</b> Overwash Areas, Beach/Panicgrass Dune Grassland, Atlantic Coast Interdune Swale, Maritime Red Cedar Woodland	American oystercatcher, sanderling, whimbrel, migratory shorebirds, beach dune tiger beetle, little wife underwing
<b>Salt Marshes:</b> Spartina High Salt Marsh, Spartina Low Salt Marsh, Salt Panne	black rail, clapper rail, least tern, gull-billed tern, black skimmer, willet, saltmarsh sharp-tailed sparrow, seaside sparrow, coastal plain swamp sparrow, Henslow's sparrow, American black duck.
<b>Impounded Wetlands:</b> Emergent Freshwater & Brackish Marsh, Coastal Plain Depressional Ponds, Twig-Rush Peat Mat Bog, Button-Bush Coastal Plain Pond	American black duck, northern pintail, migrating dabbling ducks, snow goose, Canada goose, Virginia Rail, Forster's tern, least bittern, American bittern, short-billed dowitcher, American avocet, greater/lesser yellowlegs, alewife, blue-backed herring, American eel, hickory and American shad, striped bass, rare peat bog plants, rare obligate amphibians
<b>Upland Forests:</b> Southern Red Oak/Heath Forest, Mesic Coastal Plain Oak Forest, Coastal Plain Loblolly Pine Forest, Mesic Coastal Plain Mixed Hardwood Forest, Pond Pine Woodland, Mesic Coastal Plain Rich Forest	Delmarva fox squirrel, bald eagle, black and white warbler, wood thrush, scarlet tanager, yellow-throated vireo, Kentucky warbler, great-crowned flycatcher, Northern flicker, whip-poor-will, bay-breasted warbler, other breeding and migrating landbirds
<b>Forested Wetlands:</b> Red Maple/Seaside Alder Swamp, Atlantic White Cedar/Seaside Alder Saturated Forest, Swamp Cottonwood Coastal Plain Pond	Acadian flycatcher, prothonotary warbler, yellow-throated vireo, Delmarva Fox Squirrel, migratory landbirds
<b>Early Successional Uplands:</b> Early Successional Forested areas, Scrub/Shrub Habitats, Herbaceous Farmed Areas	prairie warbler, brown thrasher, whip-poor-will, willow flycatcher, western towhee, field sparrow, Northern bobwhite, Henslow's sparrow, coastal plain swamp sparrow, maritime sunflower borer moth, migratory landbirds and waterfowl

### 3.2.5 Prime Hook FMU Safety Considerations

The safety of wildland firefighters and the public is paramount in all fire management activities. A significant threat to the public is entrapment by rapidly moving fires. A particular concern is for hunters, visitors, or neighbors who take action without proper training or means of communications. Public access must be restricted or prohibited as needed during fire operations.

Marsh fires under extreme conditions will rapidly move from a point of origin. These fires may burn toward the beach communities or other, more scattered WUI areas along the boundaries, into the Refuge headquarters area or threaten isolated structures. Direct action to control a fire can be limited by lack of access. Firefighter safety may dictate strategies and tactics that provide for structure protection with minimal attack until safe access allows actions to follow wildland fire safety guidelines, including the Fire Orders and Watch Outs. Lack of fuel breaks near homes may preclude or limit use of strategies and tactics that involve burning out or backfiring. Well-timed firing from roadways might assist containment, even though its use is limited.

The most appropriate control strategy when multiple structures are involved may be to use water streams to prevent spotting from homes already on fire to protect the other structures as possible. Given the conditions likely during cold front passages, specifically increased wind speeds, use of aircraft for fire operations might be out of the question or have very limited success.

Smoke from a wildland fire, particularly smoke drifting onto a roadway, is a concern. Incident Commanders or first responders who observe or anticipate such to occur, must inform the local dispatch office, who will notify the Delaware State Police and the Milton and Milford Police Departments that smoke may be a safety hazard and roadblocks may be needed.

A major concern is a wildfire which could spread from Refuge lands to adjacent inhabited private property. The IC is responsible to warn the public to evacuate potentially dangerous areas. This is an especially important consideration for any fires near the three beach communities; however, there are other boundary areas where this also may be a concern.

Fire intensities and/or smoke may preclude safe passage. Traffic congestion on the narrow roadways may impair timely arrival of fire resources. Temporary road closures and/or parking restrictions will be employed to ensure a timely and efficient initial response. If adequate Refuge personnel are not available, the local sheriff and other law enforcement personnel, local fire department, highway department units or suitably trained and equipped volunteers will be used.

Local news media may frequently arrive unannounced at wildland fires. Incident Commanders and Burn Bosses must assure that media activities do not jeopardize the safety of firefighters or the effectiveness of on-going operations. All media fireline visits will follow procedures established by the National Wildfire Coordinating Group and no media personnel will be permitted on fire lines without required personal protective equipment and an appropriate fireline qualified escort with communications to the IC or Burn Boss. The Refuge Manager, Zone FMO and IC need to order a Public Information Officer (PIOF) as soon as possible for incidents that are likely to become large fires and threaten nearby lands and homes.

## 4.0 Wildland Fire Operational Guidance

*By this reference, the policy and procedure guidance in the corresponding chapters of the current edition of the Interagency Standards for Fire and Fire Aviation Operations, (aka the Red Book) is incorporated into this plan, and must be followed.*

### Refuge Operational Fire Management Objectives

- Conduct all fire management programs in a manner consistent with applicable laws, policies, and regulations.
- Maintain Memorandums of Understanding with local fire agencies and protection districts to promote cooperative prevention, suppression, and prescribed fire activities.
- Work with local and State partners to prevent unwanted ignitions.
- Fully investigate all human-caused wildfires to determine who was responsible and possibly liable for suppression/resource damage costs.
- Make an appropriate management response (AMR) to wildfires that minimizes risk to firefighter and public safety, protects infrastructure and resource values, and considers costs and potential impacts of actions.
- Reduce and maintain fuels in WUI and non-WUI areas at reduced levels to provide for public and firefighter safety, protection of WUI communities and other values, including habitats critical to species of conservation concern and the integrity of Refuge ecosystems.
- Use prescribed fire and other treatment methods, where appropriate, to meet hazardous fuel reduction and habitat management goals or objectives.
- Implement cost effective monitoring to determine if management objectives for treatments are being met and to refine treatment prescriptions to better achieve objectives.
- Educate the public regarding the role of fire within the Refuge. Integrate fire ecology, management, and prevention themes into existing interpretive and education programs.
- Minimize and repair ground and habitat damage caused by incident actions following guidance contained within the Red Book, Chapter 11.

### 4.1 Appropriate Management Response (AMR)

Details of Refuge guidance for wildfire response are included in section 3.2.3.

#### 4.1.1 Overview of AMR Direction and Constraints

The operational roles of federal agencies as a partner in the Wildland Urban Interface are wildland firefighting, hazard reduction, cooperative prevention and education, and technical assistance. Structure fire suppression is the responsibility of local governments. Federal agencies may assist with exterior structural protection activities under formal Fire Protection Agreements that specify the mutual responsibilities of the partners, including funding. (620 DM 1.4)

Refuge fire management programs will consider the impact on other interagency and state programs plus local resources, and coordinate common policies, prescriptions and management responses to fire occurrences when managing fires that cross Refuge boundaries. Refuge staff will work with state and local departments, potentially affected communities, and neighboring individuals to prevent unauthorized and careless ignition of wildland fires. The Refuge is a partner in wildfire/urban interface areas, providing assistance to wildland firefighting in the form of personnel, equipment, and/or technical advice.

The Refuge currently has few qualified firefighters, and therefore depends heavily on two local fire departments, the Milton Fire Department, Inc. and the Memorial Volunteer Fire Co. (Slaughter Beach). The resources of these departments are typically the primary first responder to Refuge wildfires. A Memorandum of Understanding (MOU) or other Agreement type allows the Fire Chief or superior officer to assume command of all phases of a fire on the Refuge, from detection and initial attack through fire control and extinguishment. Local agreements will specify who, how, and when volunteer fire departments will inform the Refuge of any responses to fires on Refuge property.

These companies are dispatched by the Sussex County 911 dispatch. The local fire chief has the authority to order in additional resources and equipment as needed, subject to approval by the Refuge Manager and the limitations in the signed agreements and this FMP.

The Delaware Department of Agriculture's Forest Service may also be called upon for any wildfire incident by local departments or Refuge personnel. The Refuge maintains a cooperative agreement with the Delaware Forest Service which includes both suppression of wildland fires and assistance in conducting prescribed burning activities.

Additional Service fire resources within two hours of the Refuge include personnel and equipment from Blackwater NWR.

Mutual aid resources responding from Volunteer Fire Departments (VFDs) or fire districts to Refuge fires are not required to meet FWS fire qualification standards, but must meet the standards set by their own department. Mutual aid resources will be the first priority for release.

A FWS employee may assist the VFD as Resource Advisor for extended attack or longer duration fires. Provided the NWCG wildland fire qualifications are met, a FWS employee may also be used to establish a unified command or assume incident command as needed.

#### 4.1.2 Preparedness

Delaware's wildland fire season in Sussex County is generally from March through mid-May and then again from mid-September to mid-November, when often the fuels are cured, the weather is dry, relative humidity is low, and winds are stronger than in spring and summer.

Preparedness includes many duties of the staff listed in Appendix D, including budget planning, equipment acquisition and maintenance, tracking fire danger conditions, recruitment and hiring, and personnel training. A table with Annual Readiness Activities is included in Appendix F.

The Zone Fire Cache is at Blackwater NWR. At the Refuge, personal protective equipment (PPE) is issued to fire qualified staff, along with a limited supply of hose and hand tools. The Zone FMO is the contact for additional supply/equipment needs.

Refuge-specific activities should include an annual meeting between the Refuge Manager, the Zone FMO, and the VFD leadership, preferably before the spring or fall fire season, to review the respective agreement and annual operating plan (AOP) and update contact names and information. In addition, an annual meeting between Refuge staff and the Zone FMO should be scheduled to review and update fire management plans, activities, and update fire program information.

The National Fire Danger Rating System (NFDRS) weather station at Prime Hook NWR is used to develop fire danger indices. (Charts of the indices are in Appendix D). The indices are used to trigger the actions in the step-up plan to respond to increasing fire danger conditions. A Staff Readiness Step-up Plan in Appendix D lists additional management actions when fire danger is at very high and extreme levels, including those related to fire prevention, coordination, and fire resource availability. Step-up activities will be coordinated between the Refuge Manager and the Zone FMO. The Zone FMO will monitor fire danger, predicted weather, national and area preparedness levels, and will inform the Refuge Manager when actions are needed.

Training and physical fitness testing for fire-qualified Refuge employees within the Zone are coordinated by the Zone FMO, and follow the current guidelines of the Red Book.

#### 4.1.3 Detection

The Refuge relies on neighbors, visitors, staff, and cooperators to detect and report fires. The Fire Directory (Appendix E) contains a list of information to gather during an initial fire report and the proper contacts to initiate a prompt and effective initial attack by the closest local resources. This Appendix will be reviewed and updated annually with names and contact information. Copies will be kept at the Refuge office and with local cooperators.

The Fire Management Plan does not distinguish human-caused and lightning caused fires. All wildfires will receive an appropriate management response. Detection will include a determination of fire cause. Human-caused fires may need to be investigated by law enforcement personnel. For serious human-caused fires, a qualified arson investigator will be requested.



A fire operations map is included in Appendix A. The map should be updated as needed to include infrastructure such as main roads, Refuge roads and gates, water sources including main ditches and canals, mutual aid zones, hazards such as power lines, sensitive cultural and natural resource zones, and restricted vehicle access areas.

#### 4.1.4 Initial Response and Initial Attack Operations

Engines are the primary initial attack resource on the Refuge because of the predominance of areas with fine fuels, plenty of water sources, and suitable vehicle access. Locked gates in some areas will allow an incident to be secured from non-incident personnel. Emergency responders will need to have access; this subject should be part of the Annual Operating Plan review.

The IC and arriving initial attack suppression resources will attempt to determine fire cause, looking for suspicious activity while enroute to the reported fire location. ICs will request formal investigation as needed, including recommending that the Refuge Manager order a qualified arson investigator when a fire involves loss of life, serious injury, or significant property loss. Policy does require the Refuge Manager to investigate each and every human-caused fire; the level of investigation will be determined by the factors stated above.

The Refuge Manager will ensure that a qualified Incident Commander (IC) is assigned for each fire occurring on the Refuge. Chapter 3 of this FMP contains information useful for refuge ICs. Additional job aids and other IC tools are in the Red Book.

Refuge radios and Zone fire radios will be programmed with the frequencies in Appendix H to ensure communications capability with partners in the Refuge area.

#### 4.1.5 Extended Attack and Large Fire Management

When initial attack does not result in fire containment, the IC will notify the Refuge Manager or the 911 dispatch office, who will notify the Refuge Manager. If the RM is not available, dispatchers can use the contact list in the Fire Directory (Appendix E) to ensure the Service is properly notified. The Refuge Manager should designate a Refuge liaison or Resource Advisor to gather information at the site, in coordination with the Zone FMO. The Zone FMO or designee will assist the Refuge Manager with these tasks:

- Preparing an incident analysis (WFSA or WFDSS) and recommended management level
- Ordering appropriate additional resources
- Completing a delegation of authority if needed (example in Appendix J)

Additional duties and responsibilities of the Refuge Manager and resource advisors during extended attack and large fire management are listed in the Red Book

#### 4.1.6 Aviation

The Refuge makes limited use of aircraft. All aircraft and pilots used will meet certification requirements of the DOI Aviation Management Directorate and will have qualified personnel assigned, based on the missions to be accomplished. Consult with the Zone FMO regarding aircraft safety, procedures, and use.

#### 4.1.7 After-Action Reviews and Critiques

An After Action Review (AAR) will be conducted after all wildfires involving FWS personnel. It will focus on performance standards to enable managers and firefighters to discover for themselves what happened and why, and how to sustain strengths and improve on weaknesses. The ranking FWS person or the IC will document the AAR.

The Refuge Manager and Zone FMO (or staff) will conduct formal fire critiques in the event of injury/accident, property or resource damage, significant safety concerns, and all extended attack or longer duration incidents. Other events may trigger regional or national review, as required in the Red Book.

#### 4.1.8 Reports

MOUs with local Fire Departments detail timely reporting of their actions and costs. Cost reimbursement invoices will be verified by the Refuge Manager and forwarded to the Zone FMO for further action.

The Refuge will report wildfires using the appropriate report form in Appendix K. These reports will be completed by the Refuge Manager or designate and submitted to the Zone FMO within 10 days of a fire being declared out, for the following types of wildfires:

- All wildfires on FWS and FWS-protected lands, regardless of who responds
- Natural outs
- Escaped prescribed fires
- False alarms.

The Zone FMO will ensure data entry into the FWS Fire Management Information System (FMIS). The FMO will ensure that all expenses or items lost on the fire are reported, that timekeepers are advised of all fire time and premium pay to be charged to the fire, and that expended supplies are replaced.

### **4.2 Hazardous Fuels Management**

#### 4.2.1 Prescribed Fire Program for Hazardous Fuels and Habitats

The Refuge has met its NEPA requirement for a prescribed fire program through the approved Environmental Assessment (2009), and thus project level NEPA compliance is not required.

*By this reference, guidelines and procedures of the current Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, and corresponding chapters of the FWS Fire Management Handbook and the Red Book are incorporated into this FMP and must be followed.*

#### 4.2.1.1 Prescribed Fire Program Goals, Objectives and Scope

The information in this sub-section supplements the information in 3.2.4.

As an ecological process, fire has been and will continue to be a significant influence in restoring and maintaining wildlife habitats. Most species have evolved responses and adaptations to fire; some cannot be maintained in a region without fire's periodic influence.

Fire in many wetlands may be used to enhance waterbird habitat by reducing and re-mineralizing litter, increasing structural diversity, enhancing productivity of some marsh plants, and stimulating food production to enhance waterfowl and certain invertebrate populations. Fire may help eradicate invasive plants, such as *Phragmites australis*, in combination with herbicide. The Refuge will consider historic marsh fire regimes, the phenological cycle of native marsh plants, and the life cycle needs of marsh wildlife, when developing burn prescriptions for wetlands.

A variety of successional stages can be maintained with prescribed fires, contributing to overall habitat diversity. Fire further contributes to species diversity in that it may be used to assure that particular, fire-tolerant or fire-adapted species and communities are maintained. In general, catastrophic, stand-replacing fires cause significant, but often short-term adverse impacts on large areas of wildlife habitat. Such sites eventually re-vegetate and repopulate, through secondary successional processes. In grasslands and shrub lands, fire can restore early successional habitats, by increasing grass cover and productivity and reducing cover of tall forbs, by re-mineralizing litter, by retarding woody plant invasion, and by increasing community diversity. Prescribed fire may also be used to maintain an interspersed of shrub- and grass-dominated communities attractive to mid-successional, shrubland passerines.

Anthropogenic fire exclusion has impacted native eastern habitats, especially forests, including diminished oak regeneration and the build-up of fuels to levels conducive to intense wildfires. In many cases, prescribed fire can address such issues by increasing oak recruitment and reducing threats of catastrophic wildfires through hazard fuel reduction.

Fire may be used to restore certain Refuge forest habitats, used by Neotropical forest interior birds, to a more natural structure and vegetative composition. Fire can also be used to restore early successional habitats for declining grassland and shrubland breeding birds. Fire may be used to help eradicate exotic, invasive plants from Refuge lands, such as introduced cool season grasses, and may reduce the need to use chemical herbicides or reduce the amount of chemicals needed to control invasive species.

When assessing the effectiveness of fire in wildlife management, it is important to consider the life

cycles of plants and other species, and the fire regimes to which they are adapted. Burn prescriptions should take into account fire frequency, season of the fire, and its severity, duration, and size. Each of these factors can have specific consequences for a plant or animal species. For example, a plant or insect species may be eliminated from a site if fire occurs too often, or during the wrong part of the organism's life cycle.

#### 4.2.1.2 Regional and National Preparedness Levels

National and Geographic Area Preparedness Levels indicate the relative extent of fire activity and the size of resource commitment; levels are numbered 1 to 5, with 5 being highest. At each level a set of recommended actions and limitations applies. When State, Area, and National Preparedness Levels are different, guidelines for the highest level will be followed. The following procedures apply at national preparedness levels 4 and 5:

- Level 4: Before ignition, the Regional Fire Management Coordinator must approve all planned and approved prescribed fires. Approval must be based on an assessment of risk, impacts of proposed actions on Area resources and activities, and include feedback from the Geographic Area Multi-agency Coordinating Group (GMAC).
- Level 5: Before ignition, the Regional Fire Management Coordinator must approve all planned and approved prescribed fires, ensuring that local resources are available to carry out the application without additional outside resource needs. Approval must be based on an assessment of risk, impacts of proposed actions on Area resources and activities, and any feedback from the GMAC. If outside resources are required, the FWS representative on the national MAC Group must assess risk and impacts of the proposed action and present the project to the National MAC Group for review prior to proceeding.

#### 4.2.1.3 Project Planning

Burn complexity depends on project fuels/vegetation, objectives, boundaries, and size. Complexity analysis follows the Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, which specifies elements required in an approved Prescribed Fire Burn Plan and the peer review requirements.

Prescribed fires will be used to accomplish land and resource management objectives in accordance with the Refuge CCP and will be carried out only under a written and approved Prescribed Fire Plan. The Zone FMO or designee will write plans for the proposed treatments. The FMO will ensure that personnel have and maintain qualifications necessary to implement prescribed fires.

All burn plans will include monitoring for smoke impacts. Test fires will be used to assess smoke dispersal. Weather forecasts for the day of the burn and the next two periods must be obtained. Wind direction and ignition patterns will be carefully prescribed to avoid impacts on roadways and air traffic. Warning signs or road guards will be used to advise motorists of a prescribed fire in progress, especially if smoke could reduce visibility. Refuge roads adjacent to burn units will be

closed temporarily as needed.

Plans must include procedures and timeframes for appropriate notification of cooperators, other agencies, neighbors, media, and members of the public likely to be impacted by a prescribed fire.

Project planning must begin six to ten months in advance of implementation, or longer if pre-burn preparation must occur during a specific phenological stage of the vegetation to be treated. Preparation of treatment areas may be assigned to qualified personnel or a contractor. If a project requires mechanical treatment prior to burning, the preparation will be identified in the burn plan.

Annual burn plans will begin with consultation between the Zone FMO or designee and the Refuge Biologist and other staff to formulate an annual prescribed fire plan. The completed plan is submitted for review to the Project Leader and then goes through a technical review process locally as coordinated by the Zone FMO and then is submitted to the Regional Fire Management Coordinator for further review. Final approval of prescribed fire plans is made by the Regional Refuge Supervisor. The Refuge Manager will approve individual burn implementation using the Agency Administrator approval checklist.

Procedures and a checklist for implementing debris burns on the Refuge are included in Appendix L. Such projects do not need to meet all the requirements for prescribed fires.

#### 4.2.1.4 Project Implementation

To implement a prescribed fire, the Zone FMO will assign a qualified Burn Boss, who will follow all the guidelines and procedures of the Prescribed Fire Burn Plan. The Burn Boss will ensure all personnel have and maintain the qualifications necessary to implement prescribed fires.

The Zone FMO, Biologist, and Burn Boss must closely monitor weather and fuel conditions and other factors to take advantage of favorable conditions. This information will be shared among them as needed to schedule and implement the project.

Cooperators, contractors, and casual hires (ADs) may be used to implement prescribed fires. ADs must meet FWS standards. Cooperators, such as members of Volunteer Fire Departments, must have appropriate qualifications certified by their agency. Those who supervise FWS employees during prescribed fires must meet FWS standards.

State air quality requirements include notifying the Sussex County dispatch office of prescribed fires before ignition begins.

A prescribed fire must be declared a wildfire by the Burn Boss when he/she determines that the contingency actions have failed or are likely to fail and cannot be mitigated by the end of the next burning period. A prescribed fire can be converted to a wildfire for reasons other than an escape. An appropriate management response will be made to such incidents and a formal analysis undertaken to determine AMR options as needed. The Refuge Manager and Zone FMO will be notified of a problem fire or a converted prescribed fire.

#### 4.2.1.5 Smoke Management

*By reference, this section incorporates the text of the Red Book related to Smoke Management and Air Quality and the latest edition of the NWCG Smoke Management Guide for Prescribed and Wildland Fire.*

Full consideration of air quality values will be made in fire management planning and operations. Smoke can have serious health effects, especially for those with pre-existing respiratory problems. Reduced visibility has contributed to numerous roadway fatalities.

Local air quality is affected by regional issues. In general, air quality is good in winter and spring, but only fair in summer and fall. From Memorial Day to Labor Day, Sussex County is often in non-attainment status for National Ambient Air Quality Standards (NAAQS). Limiting smoke impacts is important to protect public health and ensure traffic safety. State Highway 1, a major north-south route from Wilmington to nearby beach resorts is just west of the Refuge.

Smoke impacts on air quality vary depending on time of year, fuel loading, and fire location. Effects are normally minimal except for large, intense wildfires, which often result in visual impairment and reduced air quality for the fire duration. Such fires tend to occur when conditions are hot and dry and their impacts cannot be predicted or controlled. Much of the Refuge prescribed burning is done in fine fuels which burn out quickly and normally have no smoke impacts. Prescribed fire plans for units where fuel burnout may result in longer duration fires with potential smoke impacts will include mitigation measures and contingencies to minimize smoke impacts.

The Air Quality Management section of the State of Delaware Department of Natural Resources and Environmental Control (DNREC) manages compliance with the Clean Air Act within Delaware. An Application for Prescribed Burning must be submitted by mail or by fax to the Dover office prior to prescribed fire ignition -- at least one day, but preferably up to ten days in advance. Applications are typically handled and responses made the day an application is received. An application form is on the DNREC web site at <http://www.awm.delaware.gov/AQM>. If burning is expected outside the hours 8 AM to 4 PM, a rationale for such is needed in the application. A copy of maps or burn plans will be appended to the application, as requested.

Modeling and tracking of smoke plumes will use computer programs, weather forecasts and on-site real-time monitoring as applicable. Potential impacts to off-Refuge communities and roadways will be assessed and information shared with respective agencies. As needed, vehicles or aircraft will be used to monitor smoke. Monitoring data will be made available as requested. DNREC personnel will be allowed on-site during prescribed fires for observation purposes as needed to accomplish their regulatory mission.

The Refuge will manage smoke from prescribed fires to avoid and minimize impacts to smoke-sensitive sites during prescribed fires and, to the extent possible, during wildfires. Sensitive areas will be identified in Burn Plans. When prescribed burning is adjacent to roads and highways, the monitoring plan will take the potential impacts into account. The monitoring plan will describe

the monitoring methods to determine the extent to which objectives are or are not met or exceeded. This may include both monitoring locations and objectives, which may include such things as maintenance of acceptable highway visibility, allowable loss of detail/clarity of key features, number of consecutive hours the visual range is below a specified standard, or the like.

Potential actions to mitigate smoke impacts may include:

- Public and cooperator notification, news releases, and radio messages (see section 4.4)
- Increasing firing so more fuels burn in flaming combustion
- Using natural barriers or constructing check lines to halt fire spread as conditions change
- Mopping up smoldering fuels until conditions improve, when the fire may be re-ignited
- Extinguishment of all or a portion of the fire, with possible re-ignition under prescription.

#### 4.2.1.6 After-Action Reviews (AAR)

An AAR will be completed after all prescribed fires and hazardous fuels activities. It will focus on performance standards to enable agency administrators and firefighters to discuss what happened, why it happened, and how to sustain strengths and improve on weaknesses.

The Burn Boss will document the AAR. Other aspects of prescribed fires will be critiqued by the burn boss and documented in the burn plan. Formal reviews will be conducted by the Zone FMO, the Refuge Manager, and others as required in the event of an injury or serious accident, an escaped prescribed fire, serious safety concerns, or smoke impact problems.

#### 4.2.1.7 Reports

The primary report for individual prescribed fires is the burn plan, where a Burn Boss will document fire and weather observations, actions and decisions, and assess attainment of project treatment objectives.

A Burn Boss will also document completed projects on the appropriate report form in Appendix K. Completed forms will be sent to the Zone FMO for entry into the Fire Management Information System (FMIS) within 10 days of being the fire being declared out. The Zone FMO and staff will input project data into the National Fire Plan Operations and Reporting System (NFPORS) or other databases as needed.

#### 4.2.2 Non-Fire Hazardous Fuels Program.

Treatments implemented between 2002 and 2004 reduced fuels on approximately 4,000 acres of public and private lands. A combination of aerial and ground application of herbicide, prescribed fire, and mowing helped reduce wildfire risk from nearby Refuge lands for the identified WUI communities of Broadkill Beach, Prime Hook Beach, and Slaughter Beach (Federal Register, 2001). For effective fuel reduction, many areas required more than one treatment or treatments in more than one year, which has resulted in over 10,000 acres of non-fire treatments from 2002 through 2007. Most acres were treated by aerial spraying. A low-impact tracked vehicle with

mower attachment was and is used in marshes.

A brochure was developed to communicate with residents in the WUI beach communities. This program will continue and expand as outlined in the 2009 Fire Management Environmental Assessment and specified in section 3.2.4 and below.

#### 4.2.3 Processes to Identify Hazardous Fuels Treatments

Primary and Secondary WUI Treatment Zones have been identified in an Environmental Assessment. Annual treatments are expected in Primary Treatment Zones to maintain their effectiveness. A long-term monitoring plan is used to determine the need, scale, and timing of additional treatments to maintain reduced fuel loads. Treatment plans for Secondary Treatment Zones will be developed at five year intervals, based on monitoring as described in Appendix N.

Other treatments are developed in annual treatment plans that benefit species of concern, and are linked to the Refuge Habitat Management Plan or CCP.

#### **4.3 Emergency Stabilization (ES) and Burned Area Rehabilitation (BAR)**

Wildfires will be evaluated for activity-caused damage repair needs as soon as safely possible. Repair will be accomplished by incident resources. The Red Book has a more comprehensive discussion of current post-wildfire recovery policy, activities, and approval authorities.

There have been no previous ES or BAR treatments on the Refuge. ES and/or BAR treatment needs require development of plans with Regional approval and submission to the National Fire Office in Boise, Idaho, within specified time frames.

ES and BAR may be undertaken to protect and sustain ecosystems, public health, safety, and to help communities protect infrastructure. Natural recovery following a wildfire is the preferred ES or BAR treatment. Such is likely in most of the refuge habitat. When natural recovery is not likely to occur, the Refuge Manager will assign a team headed by a Wildlife Biologist and a Regional staff member to develop ES or BAR plans.

Issues potentially of concern involve habitat loss for species of conservation concern identified in Refuge CCP and HMPs when a severe wildfire in areas essentially *Phragmites*-free opens the burned area up to re-invasion or to erosive loss of soil.

Allowable ES actions in 620 DM 3 are:

- 3.7 M (2) placing structures to slow soil and water movement
- 3.7 M (7) seeding or planting to prevent permanent impairment of designated Critical Habitat for Federal and State listed, proposed or candidate threatened and endangered species
- 3.7 M (10) direct treatment of invasive plants
- 3.7 M (12) monitoring of treatments and activities for up to three years.



Allowable BAR actions in 620 DM 3 are:

- 3.8 M (2) chemical, manual, and mechanical removal of invasive species and planting of native and non-native species, consistent with 3.8F, restore or establish a healthy, stable ecosystem even if this ecosystem cannot fully emulate historical or pre-fire conditions
- 3.8 M (4) repair or replace fire damage to minor operating facilities (e.g., interpretive signs and exhibits, shade shelters, fences, wildlife guzzlers, etc.)

Repair of damage caused by AMR activities and stabilization needed to mitigate short-term effects of incident activities should be done prior to release of incident resources. The costs of these operations are included within the fire cost.

Restoration of effects caused by the fire itself should be accomplished within a one to three year period. Longer duration projects such as research and monitoring beyond a three year period will be funded through normal refuge funding sources. ES and BAR actions may not be used to restore or convert a burned area to a habitat that was not present when the wildfire occurred.

Development of BAR Plans may require a team to assess fire damage and begin plan development. This team may include refuge and regional office personnel with the specific expertise needed to address the BAR issues. The Refuge Manager or Project Leader will approve team members. Team members may need access to Refuge wildlife and vegetation inventories, cultural and historical location data, threatened and endangered and other sensitive species information, fire history, fire ecology, fire severity, and any other resource and fire data available to assess the impacts of the fire and evaluate and recommend appropriate actions.

#### **4.4 Prevention, Mitigation and Education**

##### **4.4.1 Prevention/Mitigation**

Fire prevention activities are intended to prevent human-caused wildfires. All the Refuge's wildfires have been human caused. These are potentially the most damaging fires because they can be ignited, intentionally or carelessly, when initial attack capability is low, and/or the fuels are dry and easily burn. Prevention activities will be coordinated with agencies such as the Delaware State Forest Service, during times of very high and extreme fire danger. Actions may include:

- Posting signs warning of fire conditions at visitor displays as per step-up plan
- Implementing restrictions or area closures in coordination with other agencies
- Scheduling patrols to enforce regulations such as area closures
- Maintaining contacts with cooperators and neighbors to share information.

Visitor and neighbor fire and fuel awareness may be increased through individual contacts and handouts, bulletin boards, and scheduled interpretive programs. Employees or volunteers may

need training to emphasize to the public the potential impacts of human-caused wildfires and how to prevent them, along with relating the beneficial effects of prescribed fires.

Inadvertent or intentional ignition of wildland fuels by humans is illegal. By policy, the Refuge Manager will ensure all human-caused wildfires are investigated. This may range from a cause determination during initial attack to a criminal investigation by a qualified arson investigator, as appropriate to the fire circumstances and their consequences.

Employees will be informed about fire prevention and its objectives and will be updated about changes in conditions throughout the fire season.

#### 4.4.2 Education

An outreach goal is to enhance knowledge and understanding of wildland fire management policies and practices through internal and external communication and education. Programs will be continuously improved through timely and effective exchange of information between the Refuge, the local public and state partners. This will include assisting cooperating agencies at public meetings and informal gatherings.

An important component of the WUI program is education of homeowners and landowners. Encouragement by state and local partners may motivate these individuals or groups to mitigate hazards on their property by removing vegetation, using fire-resistant building materials, cleaning leaf and needle litter from roofs and eaves, and other actions that apply FIREWISE principles.

Educating the public on the ecological role of fire and a shared concern for air quality values is instrumental in increasing public understanding of and support for Refuge prescribed fires. Shortly before prescribed burns are implemented, project information will be provided to state contacts, Refuge visitors, local citizens and the media. As feasible, when prescribed fires are conducted in areas with public access, the Refuge will use these opportunities to inform, educate, and alleviate concerns -- through interpretative displays on site and guided field trips. Such sites can be used as outdoor classrooms and may provide study sites for long-term ecological effects.

The Refuge Park Ranger will handle preparation and dissemination of information to the media, refuge staff, and other agencies for wildfires or prescribed fires. The Refuge Manager will review and approve the information before its release.

## **5.0 Monitoring and Evaluation**

### **5.1 Fire Management Plan**

#### 5.1.1 Annual Review and Update

This FMP will be reviewed annually and updated, as needed, by the Refuge Manager and the Zone Fire Management Officer, either in person or by telephone, using the checklist in Appendix M. Input for the reviews will be requested from the partners listed in section 2.3.2.

Revisions of FMPs with Regional review and concurrence are required every five years and/or following completion of a new (or significantly revised) CCP or HMP.

#### 5.1.2 Fire Management Plan Terminology

Terms in this FMP use the definitions of the National Wildfire Coordinating Group. They can be found at the NWCG website, specifically at <http://www.nwcg.gov/pms/pubs/glossary>.

### **5.2 Treatment Effectiveness**

Monitoring and evaluation are part of the process of reducing hazardous fuels and enhancing and maintaining habitats. Monitoring will be performed on all prescribed fires managed by the Refuge in accord with standard interagency methods, and as described in prescribed fire burn plans.

A WUI monitoring plan was developed by the Refuge Biologist to monitor the effectiveness of treatments during the implementation of the WUI project in 2002 through 2004. The plan and its associated monitoring protocol (an appendix to the WUI monitoring plan) are in Appendix N. This plan and protocol will be followed until revised under procedures in section 5.1.1 above or as superseded by a Refuge Inventory and Monitoring Plan, expected to be completed by 2012. The Refuge Biologist will plan and direct monitoring conducted on the Refuge, except for monitoring activities for which Burn Bosses are responsible. The Refuge Biologist will maintain all records of monitoring activities and ensure data is collected and archived systematically.

WUI monitoring will help determine the need for, size, and timing of follow-up treatments to accomplish the treatment objectives for the Primary and Secondary Treatment Zones. (See FMP Sections 3.2.4 and 4.2.) Annual visual monitoring in primary treatment zones will typically involve Refuge Biologists, the Refuge Manager, the Zone FMO, the Deputy Project Leader, and the Project Leader.

Detailed protocols are used for monitoring in the secondary treatment zone, where fifty transects were randomly located to monitor treatment response. The current protocols provide for re-reading all transects at five year intervals, beginning in 2009. This protocol may be revised to coordinate it with other monitoring or to improve monitoring cost-effectiveness once initial data from the re-read transects is collected and evaluated.

Any associated research monitoring will follow accepted scientific methods.

Data collected during prescribed fires can increase understanding of ecological effects of fire, and provide information needed to refine prescriptions. Prescribed fires will be monitored pre-burn, burn day, and post-burn. Pre- and post-burn monitoring will collect fuels and vegetation data specified in the burn plan. Data will be used to assess conditions favorable for ignition and to help measure accomplishment of project objectives, including fuel reduction and calculation of particulate emissions. Burn day monitoring will be documented to ensure the fire is within prescription. Weather variables typically monitored are dry bulb temperature, relative humidity, mid-flame wind speed and direction, and cloud cover. Measurements are taken in the field immediately prior to test fire ignition and at intervals specified in the burn plan. Post-ignition monitoring includes basic fire characteristics -- fire type (backing, heading, or flanking), rate of spread, and flame length. This aids in assessing whether the fire burned as modeled and in linking fire effects with fire behavior. Other burn-day or post-burn measurements may include percent of surface fuel consumed and burn duration. Soil moisture and soil temperature can yield important information, but are not typically measured except during research into fire effects.

Monitoring habitat response will typically use photo-points, which will be re-visited and photographed during subsequent seasons. Comparisons over time will help determine if objectives are being met. More complex monitoring may be undertaken to answer questions about fire effects on specific species or other parameters. Such monitoring can require vegetation transects, breeding bird point counts, presence/absence of species, etc.

Prescribed fire funds may be used to facilitate adaptive management for fuels treatment effectiveness. Use of the funds is limited to monitoring first and second order effects of fuels management projects (e.g. prescribed fire, mechanical or chemical fuel treatments) on fuel and wildlife habitat composition and structure. Fuels management effectiveness monitoring should be described in Refuge habitat management or monitoring plans and should include:

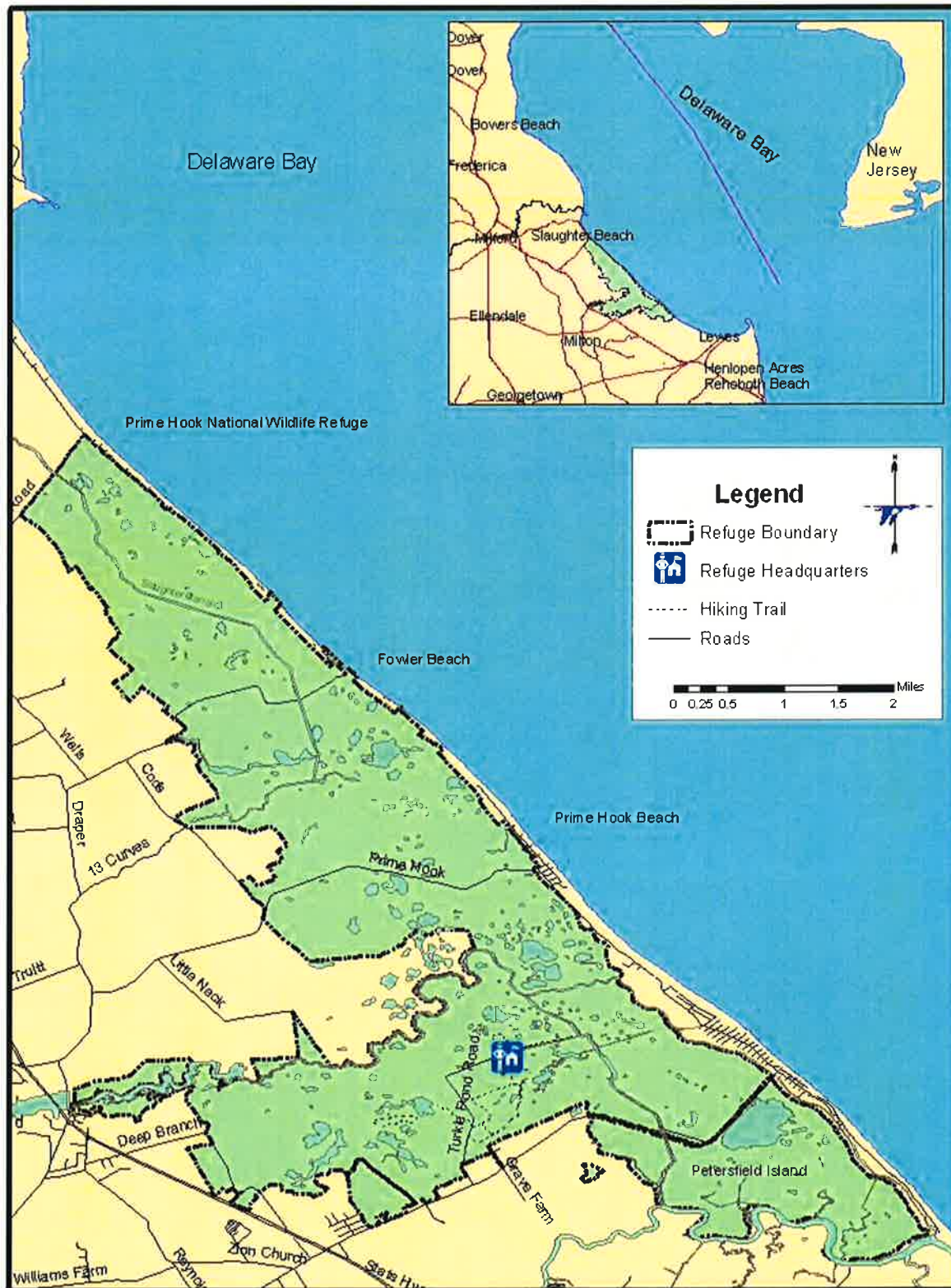
- List of monitoring objectives, a description of fuel/wildlife habitat monitoring attributes, and a description of monitoring protocols in detail, and citation of an approved Refuge plan that identifies the monitoring need
- List of actions to take when monitored attributes reach pre-established thresholds
- Documented commitment to implement monitoring and take specified actions.

The Regional Fire Management Coordinator and/or Regional Fire Ecologist will review proposed use of hazard fuels funds for monitoring beyond first order fire effects using these criteria:

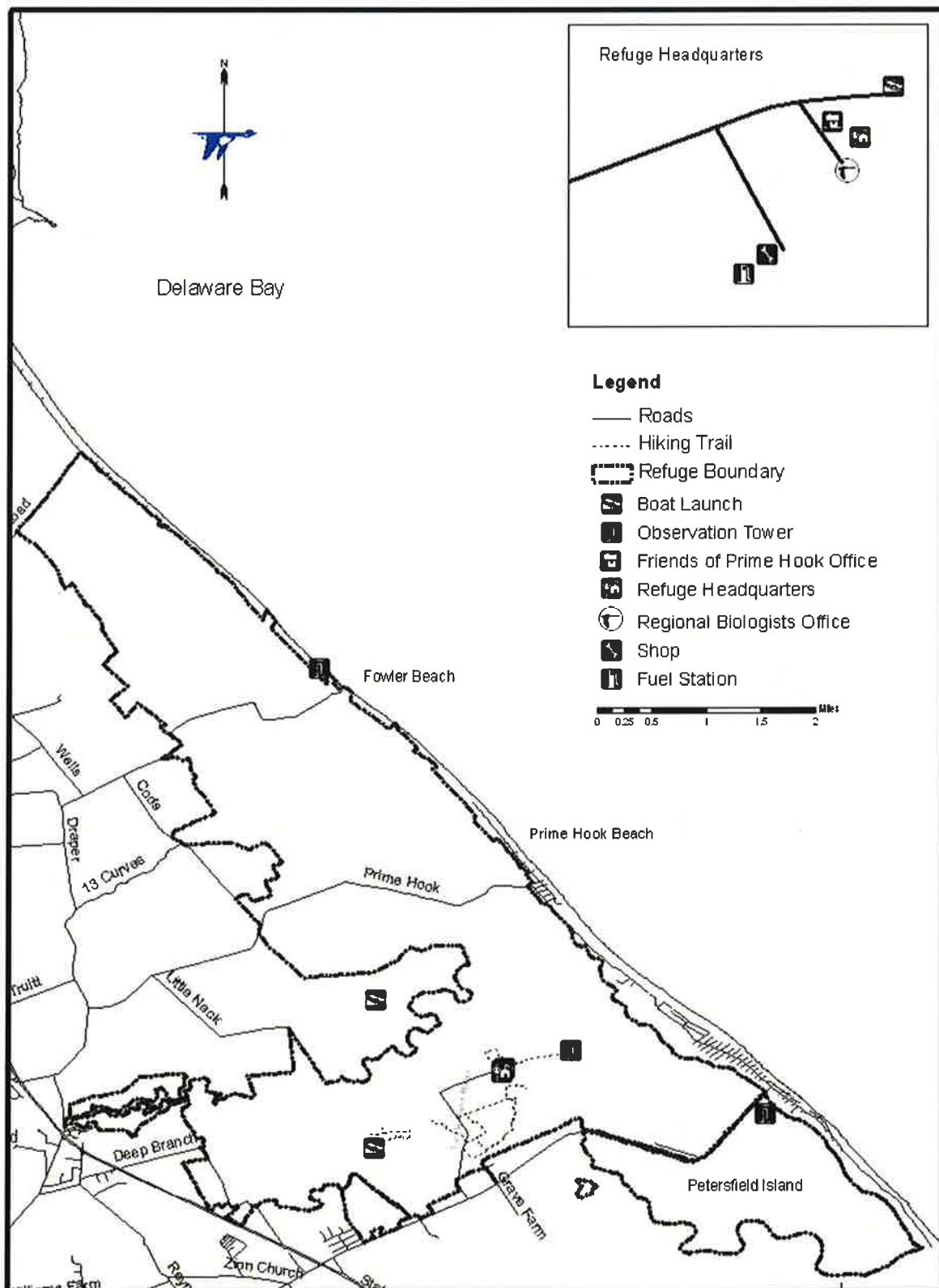
- Monitoring is adequately described in an approved Refuge monitoring plan
- Protocols conform to established fuel and wildlife habitat monitoring procedures
- Protocols are confirmed by independent review of the Regional Fire Biologist and/or Wildlife Biologist to be the most cost effective and statistically defensible means to address monitoring objectives
- All stakeholders are aware of changes that may result from the monitoring.

## Appendix A – Maps

Map A1: Refuge Vicinity Map

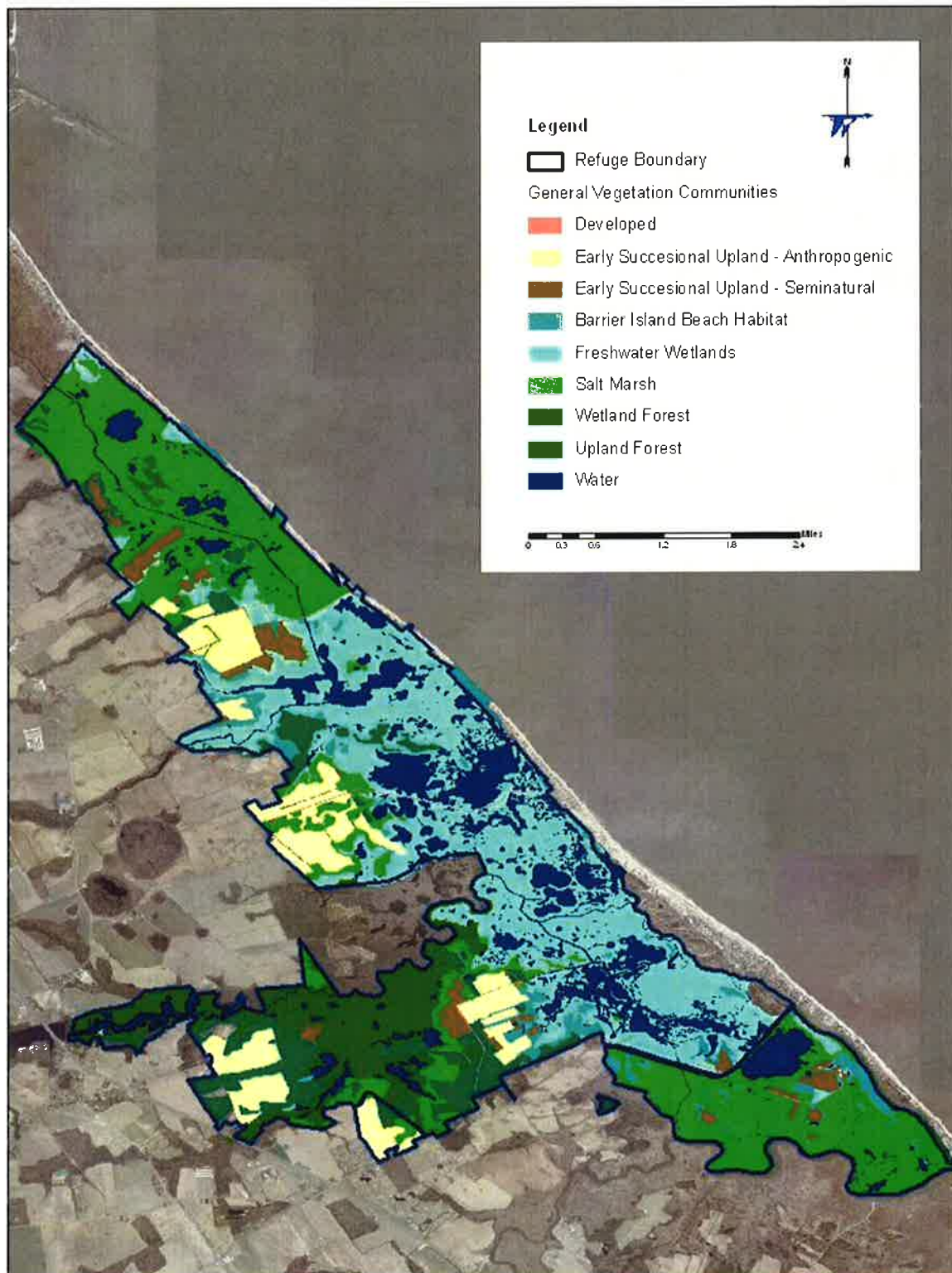


Map A2: Refuge Operations Map

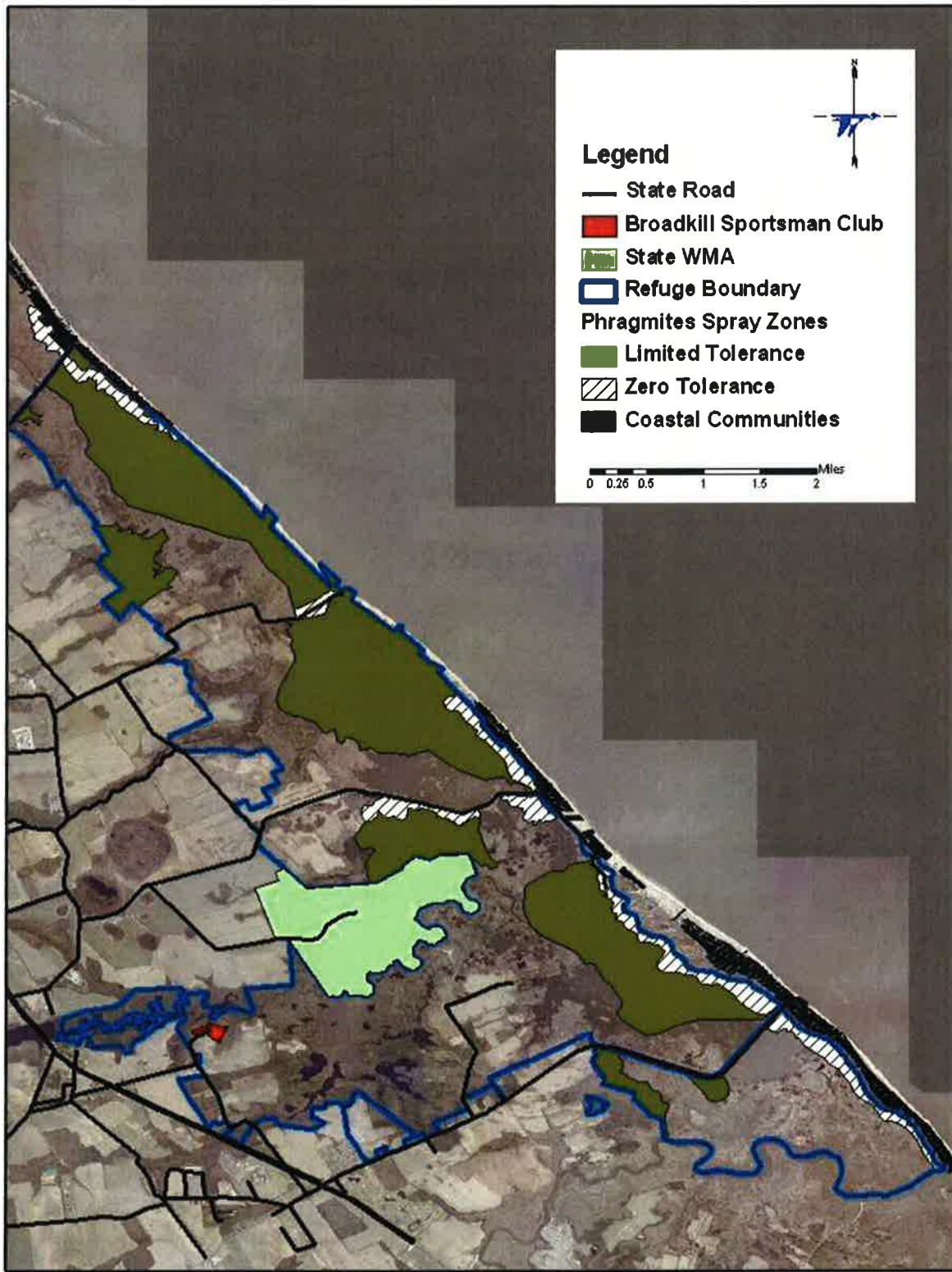




Map A3: Refuge Vegetation Cover Type Map



Map A4: Wildland Urban Interface (WUI) Treatment Map





## **Appendix B – Authority and Policy References**

The following statutes authorize and provide the means to manage wildland fires on Service lands or those that threaten FWS lands, and on adjacent lands.

**A. Protection Act of September 20, 1922** (42 Stat. 857; 16 U.S.C. 594) Authorizes the Secretary of the Interior to protect, from fire, lands under his/her jurisdiction and to cooperate with other Federal agencies, States, or owners of timber.

**B. Economy Act of June 30, 1932** (47 Stat. 417; 31 U.S.C. 1535). Authorizes Federal agencies to enter into contracts and agreements for services with each other.

**C. Reciprocal Fire Protection Act of May 27, 1955 as amended by the Wildfire Suppression Assistance Act of 1989** (69 Stat. 66, 67; 42 U.S.C. 1856a)(102 Stat. 1615). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency facilities in extinguishing fires when no agreement exists.

**D. National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 and the Refuge Recreation Act of 1962.**(80 Stat. 927)(16 U.S.C. 668dd-668ee)(16 U.S.C. 460k-460k4). Governs the administration and use of the National Wildlife Refuge System.

**E. Disaster Relief Act of May 22, 1974.** (88 Stat. 143; 42 U.S.C. 5121). Authorizes Federal agencies to assist State and local governments during emergency or major disaster by direction of the President.

**F. Federal Fire Prevention and Control Act of October 29, 1974 et seq.** (88 Stat. 1535; 15 U.S.C. 2201) as amended. Authorizes reimbursement to State and local fire services for costs incurred in firefighting on Federal property.

**G. Federal Grants and Cooperative Act of 1977.** (Pub. L. 95-244, as amended by Pub. L. 97-258, September 13, 1982. 96 Stat. 1003; 31 U.S.C. 6301-6308). Eliminates unnecessary administrative requirements on recipients of Government awards by characterizing the relationship between executive agencies and contractors, States and local governments and other recipients in acquiring property and services in providing U.S. Government assistance.

**H. Supplemental Appropriation Act of September 10, 1982.** (96 Stat.837) Authorizes Secretary of the Interior and Secretary of Agriculture to enter into contracts with State and local government entities, including local fire districts, for procurement of services in pre-suppression, detection, and suppression of fires on any unit within their jurisdiction.

**I. Wildfire Suppression Assistance Act of 1989.** (Pub. L. 100-428, as amended by Pub. L. 101-11, April 7, 1989). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of

agency facilities in extinguishing fires when no agreement exists.

### **Policy References**

1. Department of Interior Manual, 620 DM 1-3, Wildland Fire Management, General Policy and Procedures; Wildland Fire Management, General Policy and Procedures – Alaska; and Burned Area Emergency Stabilization and Rehabilitation
2. United States Fish and Wildlife Service Manual sections 095 FW 3 Emergency Preparedness and Response -- Wildland Fire Management, 241 FW 7 Wildland Fire Safety, 232 FW 6 Training Standards for Wildland and Prescribed Fire Operations, 621 FW 1 Wildland Fire Policies and Responsibilities, 621 FW 2 Fire Management Planning, and 621 FW 3 Prescribed Fire
3. United States Fish and Wildlife Service Fire Management Handbook
4. Interagency Standards for Fire and Fire Aviation Operations, also known as the “Red Book”
5. Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, July 2008
6. National Wildlife Refuge System Wildland Fire Management Strategic Plan (May 2006)
7. A Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment: 10-Year Strategy Implementation Plan (December 2006)
8. National Fire Plan (September 2001) and Healthy Forest Initiative (August 2002)

## **Appendix C – Regional and Refuge Staff Fire Management Responsibilities**

Refuge-specific duties supplement lists from the Red Book (*Interagency Standards for Fire and Fire Aviation Operations*.) See also general descriptions in 621 FW 1.5.

### **Regional Director**

- Responsible to the Director for fire management programs and activities within their Region

### **Regional Director, Regional Fire Management Coordinator, Project Leader/Refuge Manager and Zone/District Fire Management Officer**

- Ensure that FMPs reflect the agency commitment to firefighter and public safety, while utilizing the full range of fire management activities available for ecosystem sustainability. (*Federal Wildland Fire Management Plan 2001*)
- Ensure use of fire funds is in compliance with department and agency policies.
- Ensure that trespass actions are initiated and documented to recover cost of suppression activities, land rehabilitation, and damages to the resource and improvements for all human-caused fires where liability can be determined, as per FWS *Fire Trespass Handbook*.
- Ensure compliance with National and Regional Office policy for prescribed fire activities.
- Provide periodic reviews of the prescribed fire program.
- Annually update and review the *Agency Administrator's Guide to Critical Incident Management* (NFES 1356).

### **Regional Director and Project Leader/Refuge Manager**

- Develop fire prevention, fire suppression, and fire use standards that are compliant with agency fire policies.
- Ensure that all fire management activities are supported by a current FMP and integrated with an approved Comprehensive Conservation Plan.
- Ensure that only trained, certified fire and non-fire personnel are available to support fire operations at the local and national level.
- Ensure that master agreements with cooperators are valid and in compliance with agency policy, and that attached Annual Operating Plans are current.
- Review critical operations and safety policies and procedures with fire and aviation personnel.
- Ensure timely follow-up to fire management program reviews.
- Ensure that investigations are conducted for incidents with potential, entrapments, and serious accidents as per agency policy.
- Attend post-fire closeouts for Type 1 and type 2 fires. (May be delegated.)
- Ensure that Prescribed Fire Plans are approved and meet agency policies.
- Ensure Refuge Safety Program is in place, with an active safety committee and a current plan that includes the fire program.

### **Regional Fire Management Coordinator and Zone/District FMO**

- Establish and manage a safe, effective, and efficient fire program.
- Provide the expertise and skills to fully integrated fire and fire aviation management into interdisciplinary planning efforts.
- Ensure that only trained and qualified personnel are assigned to fire and fire aviation duties.
- Ensure completion of a Job Hazard Analysis (JHA)/Risk Assessment for fire and fire aviation activities so mitigation measures are taken to reduce risk.
- Ensure compliance with work/rest guidelines during all fire and fire aviation activities.
- Ensure that the fire and fire aviation management employees understand their role, responsibilities, authority, and accountability.
- Organize, train, equip, and direct a qualified work force. Establish and implement performance review process.
- Develop, implement, evaluate, and document fire and fire aviation training to meet current and anticipated needs.
- Ensure fire and fire aviation policies are understood, implemented, and coordinated with other agencies as appropriate.
- Monitor fire suppression activities to recognize when complexity levels exceed program capabilities. Increase managerial and operational resources as needed.
- Monitor fire season severity predictions, fire behavior, and fire activity levels. Take action to ensure safe, efficient, and effective operations.
- Ensure that master agreements with cooperators are valid and in compliance with agency policy, and that attached Annual Operating Plans are current.
- Develop, maintain, and implement current operational plans. (e.g., dispatch, preparedness, prevention).
- Ensure that fire severity funding is requested, used, and documented in accordance with agency standards and the Red Book.
- Review and approve appropriate overtime authorization requests for personnel providing fire suppression coverage during holidays, special events, and abnormal fire conditions.
- Ensure a process is established to communicate fire information to the public, the media, and cooperators.
- Annually convene and participate in pre- and post-season fire meetings. Specifically address management controls and critical safety issues.
- Oversee pre-season preparedness review of fire and fire aviation program.
- Initiate, conduct, and/or participate in fire program management reviews and investigations.
- Personally participate in periodic site visits to individual incidents and projects.
- Utilize the Incident Complexity Analysis (Red Book Appendix F & G) to ensure the proper level of management is assigned to all incidents.
- Ensure that transfer of command on incidents occurs as per Red Book.
- Ensure that incoming personnel and crews are briefed prior to fire and fire aviation assignments.
- Ensure an accurate and defensible Wildland Fire Situation Analysis (WFSa) is completed and updated daily for all fires that escape initial attack.

- Work with cooperators, groups, and individuals to develop and implement processes and procedures for providing fire safe communities within the wildland urban interface.
- Ensure training for fire cause determination and fire trespass.
- Ensure that fire season severity predictions, weather forecasts, fire behavior predictors, and fire activity levels are monitored and communicated daily to all employees (hard copy, web page, email, radio, or fax).
- Use current National and Local Mobilization Guides and ensure that national, geographic, and local mobilization standards are followed.
- Comply with established property control/management procedures.

#### **Regional Fire Management Coordinator**

- Coordinate Regional fire budget preparation and execution.
- Review Refuge hazardous fuels treatment project plans and funding requests.
- Review Refuge prescribed fire burn plans.
- May provide coordination, training, evaluation, and technical guidance to the Refuge.

#### **Project Leader/Refuge Manager**

- Responsible to the Regional Director for the safe and efficient implementation of fire management activities within the refuge, including cooperative activities with other agencies or landowners in accordance with delegations of authorities
- Attend the *Fire Management Leadership Course*. Ensure that personnel delegated fire program responsibilities have completed the *Fire Management Leadership Course*
- Provide a written Delegation of Authority to FMOs that gives them an adequate level of operational authority as needed.
- Personally visit at least one wildland and one prescribed fire each year.
- Assure appropriate management response to Refuge wildfires.
- Provide a written delegation of authority, an approved analysis and decision document, and an Agency Administrator Briefing to Incident Commanders and Teams.
- Ensure that resource advisors are identified, trained and available for incident assignment. Refer to *Resources Advisors Guide for Wildland Fire* PMS 313, NFES 1813, Jan 2004.
- Ensure that a prescribed fire plan is reviewed and recommended by a qualified technical reviewer not involved in the plan preparation before approving it.
- Ensure that a policy has been established for review and signing the go-no/go checklist.
- Ensure that current fire and weather information is posted and available for all employees.
- Ensure that Department, Service, and refuge policies are followed.
- Use the annual FMP checklist to assist in annual FMP reviews and updates.

#### **Zone/District Fire Management Officer**

- Maintain liaison with Regional Fire Management Coordinator and Cooperators.
- Advise the Refuge Manager/Project Leader on wildland fire procedures and policy.
- Coordinate and/or direct significant wildfire activities including dispatching, incident command, and advising Refuge Manager regarding operations and incident status.
- As needed, annually update the Fire Management Plan appendices for approval.
- Administer payroll, purchasing and travel for the zone/district fire staff.

- As requested, assist the Refuge plan and coordinate WUI and non-WUI hazardous fuels and resource management treatments including:
  - preparing project funding requests and tracking fund use per agency requirements
  - preparing and/or reviewing individual or annual treatment plans
  - implement fuels treatments to meet Refuge management objectives
  - providing or assisting in public information and outreach
- Plan, coordinate, and direct preparedness activities as needed including:
  - fire training, fitness testing and Fire Qualification System records
  - fire weather station operation and data entry
  - fire cache and equipment operation, maintenance, and accountability
  - monitoring fire danger indices and implementing the Step-up Plan
  - preparing annual fire program budget requests and tracking use of funds.
- Maintain fire records and review completed fire reports for accuracy.
- Administer the evaluation process on wildland fires.

#### **Refuge Biologist**

- Develop and implement annual habitat management plans.
- Review habitat treatment needs and determine treatment methods.
- Provide input into and review refuge prescribed burn plans.
- Monitor treatment effectiveness and maintain treatment records.

#### **Refuge Park Ranger**

- Serve as Refuge Information Officer for wildland fire activities.
- Implement Refuge interpretive activities, including those on wildland fire issues, especially those related to Wildland-Urban Interface and fuel treatment activities.
- Develop and update media briefings, interpretive handouts, and brochures.

#### **Fire District/Zone Dispatcher (Blackwater NWR)**

- Assist FMO in providing information regarding fire activity and danger to the RM.
- Process resource orders for Refuge operations and for Refuge personnel.
- Assist FMO and RM in filing reports, disseminating information to the Regional Office and local cooperators, and tracking expenditure of wildfire and hazardous fuels funds.

#### **Maintenance Worker(s)**

- As qualified, operate equipment such as engines, Marsh Master, and chainsaws.
- Assist refuge in implementing treatment projects.

## Appendix D – Fire Danger and Staff Readiness (Step-Up Plan)

A step-up plan lists planned management actions in response to increasing fire danger, as identified in a fire danger adjective class. As fire danger increases to very high and extreme, more actions are taken as needed. As fire danger decreases, the actions can be curtailed or ended. The Zone FMO is responsible for monitoring fire danger indices. The Refuge Manager will ensure that step-up actions are implemented, per the recommendations of the Zone FMO.

Additional actions can be taken as needed; the Step-Up Plan is only a guide. To meet short duration (2-3 days) critical fire danger conditions, this guide, supported by established BI percentiles (90<sup>th</sup> / 97<sup>th</sup> break point values) provides approved readiness actions. To cover short-term expenses associated with these activities, an emergency preparedness account can be opened. When critical fire weather / danger conditions that are forecasted to extend for a more substantial time period, and require initial attack resources of greater significance, a formal written fire severity request must be prepared, sent to the RFMC, and then approved by the national Branch Office. Consult the Zone FMO to evaluate and prepare any severity requests.

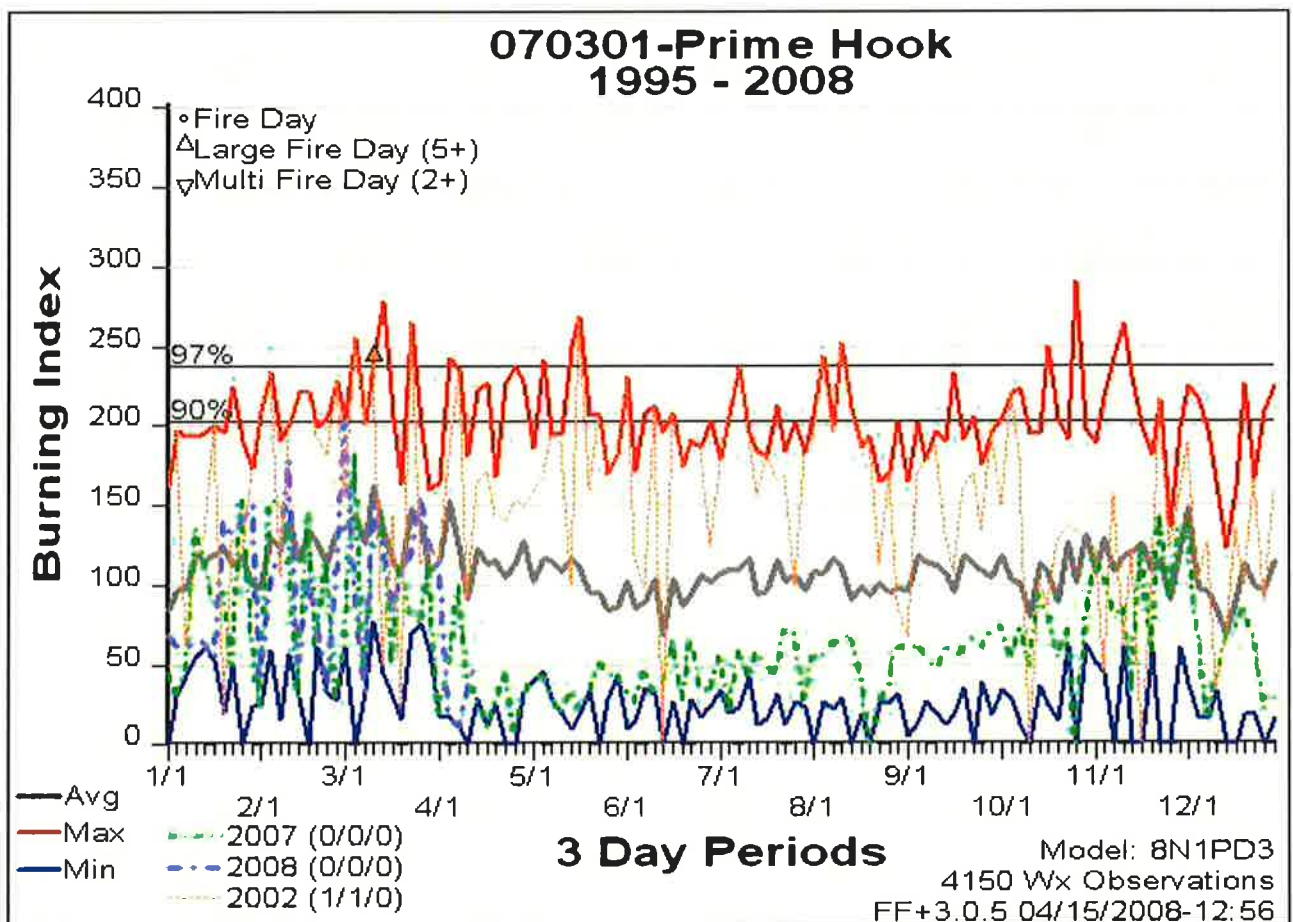
### Step-Up Plan

ACTIONS	FIRE DANGER CLASS		
	Low and Medium	High	Very High and Extreme (Above 90 <sup>th</sup> percentile)
<i>FIRE PREVENTION / DETECTION ACTIVITIES</i>			
Visitors will only use areas open to the public. Open fires and use of any fireworks or explosives are prohibited.	X	X	X
Field-going employees inform Refuge Manager of suspicious activity.	X	X	X
Warn visitors of fire danger. Staff in the field aware of increased fire danger		X	X
Consider posting fire danger signs at high public use areas.			X
Refuge Manager may close select trails and public use areas as needed.			X
<i>MISCELLANEOUS ACTIONS</i>			
Zone FMO notify Refuge Manager and Regional Fire Coordinator. Open emergency preparedness account as appropriate.			X
Zone FMO or Refuge Manager provide updates to Regional Office as appropriate.			X
Coordinate with local cooperators on short and long range planning, public notification, prevention activities, and increased cooperation.			X
Consider extending coverage hours for Refuge fire trained staff and increased IA capability			X
Refuge Manager, Zone FMO, and Regional Fire Coordinator coordinate pre-positioning of FWS staff, FWS fire resources, or partner fire resources as needed.			X

## Fire Danger Indices and Calculations

Prime Hook NWR has an automated weather system near the headquarters area that collects daily weather data to inform the program management decisions of the Project Leader and the Zone FMO. The station, number 070301, has been in use since 1996 and functions throughout the year. Daily observations are edited by either the Regional Fire Planner or the Regional Fire Management Coordinator. Maintenance is completed annually by contract under oversight of the Regional Fire Planner. While other factors will be considered, the established break points (thresholds) provide a justifiable basis for short term preparedness, longer term severity, and potential prescribed fire needs.

The charts below display calculated values for National Fire Danger Rating System (NFDRS) indices (Burning Index and Keetch-Byram Drought Index) from weather observations at Prime Hook NWR in Delaware (NFDRS station number 070301) from January 1, 1995 through December 31 of each year until the report was generated on April 15, 2008. Fuel model 8N1PD3 was used.



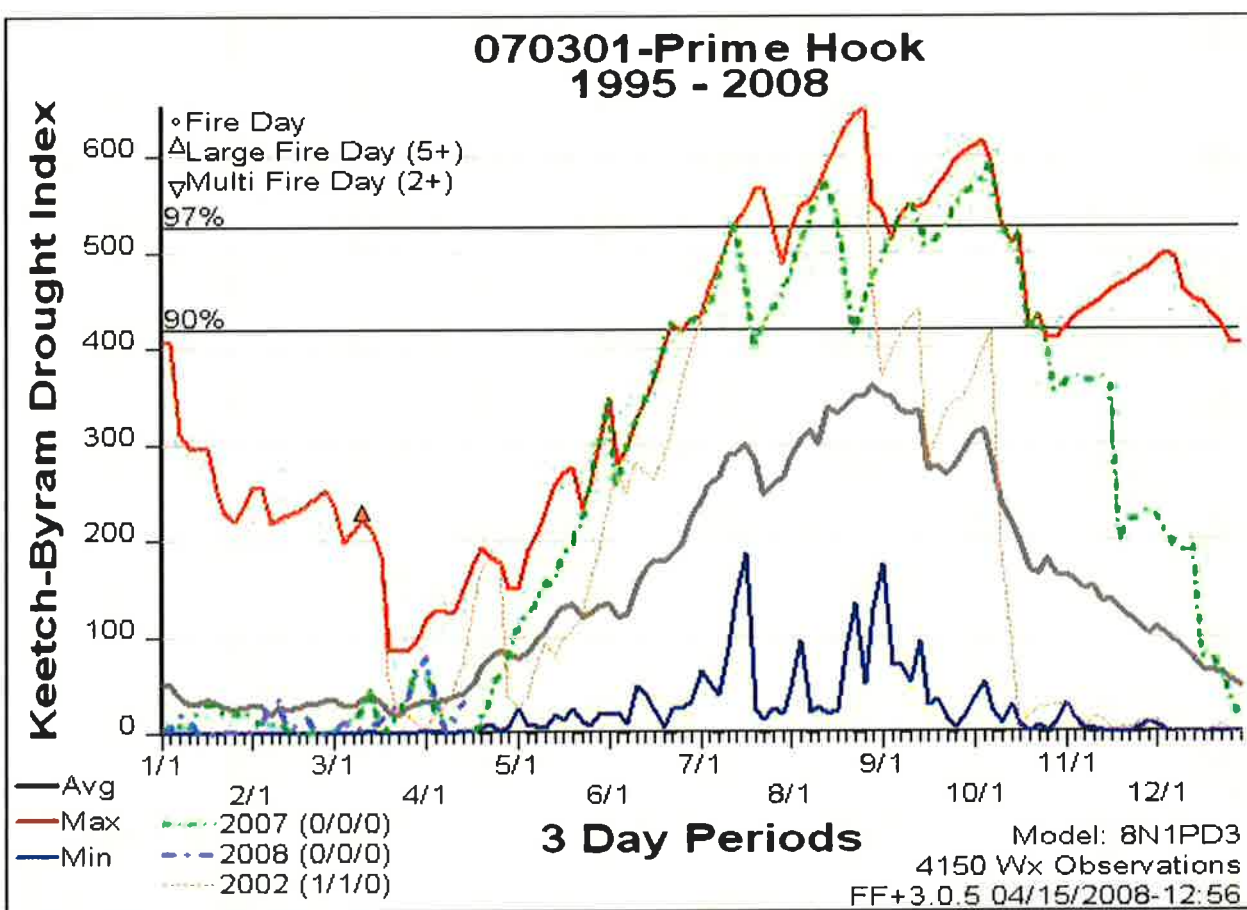
No one index captures the whole fire danger picture. The Burning Index (BI) indicates the difficulty of containing a fire. BI values are sensitive to wind, but not very sensitive to long-term fuel moisture conditions. The Keetch-Byram Drought Index indicates difficulty of control and



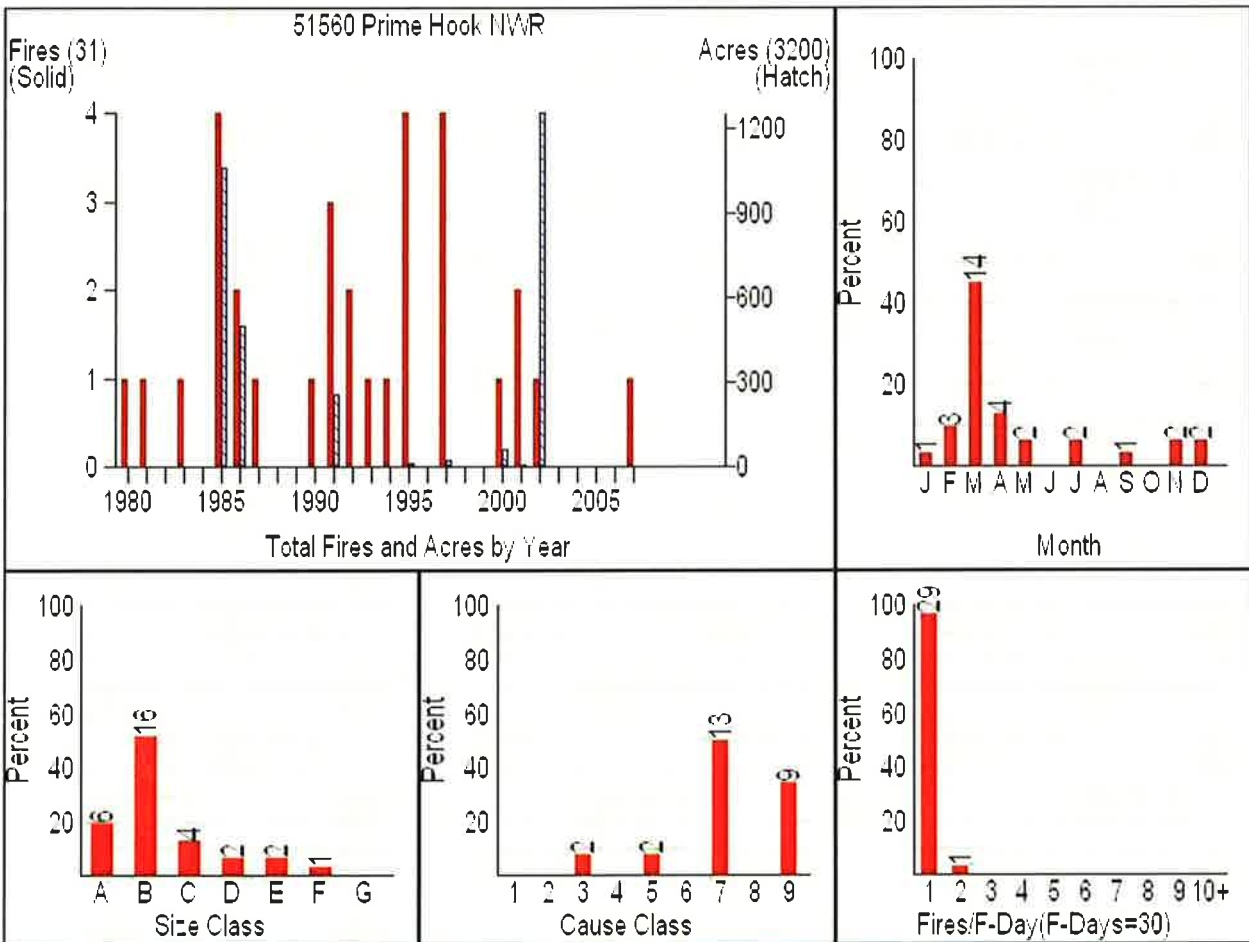
mop-up by modeling the presence or absence of drought. Among drought indices, the KBDI is best suited for lands water-saturated at some point annually, when the index value is at or near zero.

In each chart, calculated index values are on the y-axis and corresponding calendar year dates on the x-axis. An average of the calculated values for the current, the previous, and the following day are plotted for each calendar date, to smooth out anomalies or short-term effects. In the chart, the red line represents historic maximum values for a calendar date, a blue line the historic minima, and a gray line the mean for the date. Annual data for 2002, 2007, and 2008 are also plotted. Note that fire danger in 2002 was mostly well above average and 2007 it was mostly below average.

Horizontal lines at 90% and 97% of y-axis values show threshold (break point) values used for very high (90%) and extreme (97%) fire danger classes. For example, in the BI chart, an index value of 203 or higher indicates very high fire danger and 247 or higher, extreme fire danger. Similar values in the KBDI chart are 420 and 526 for very high and extreme fire danger classes, respectively.



## Fire History Summary Graphs 1980 – 2008



The graphs above display wildfire history from 31 archived fire reports. In the top row, the red bars in the first chart show number of fires; the striped bars show acres. Chart two shows that almost half the fires occurred in March (14), with the remaining 17 spread throughout the year except for June, August, and October. The first chart in the bottom row shows numbers of fires by size class; all but five were controlled in Classes A, B, or C (0 to 10 acres). The fire cause chart shows lightning caused no fires, all were the result of human activity, with the cause of 13 reported as incendiary. The last chart shows that when Refuge wildfires occur, there is only one on any given day, except for one time in the twenty nine years, when there were two.

The table below displays archived individual wildfire data from 1999 through 2008.

Fire Start Date	Fire Size (Acres)	Cause	Fire Number
12/05/2007	0.1	Other	D5WC
03/10/2002	1250	Undetermined	5626
12/29/2001	Not reported	Smoking	5696
05/13/2001	10.5	Incendiary	5476
03/13/2000	65	Debris/Vegetation Burning	5161

## Appendix E – Fire Directory

1. If a FWS employee receives a phone report of smoke or fire, ask for the following information.

**Note:** If caller is the county 911 dispatch or a VFD, employee must notify Refuge Manager and FMO as soon as possible.

Fire on Refuge lands?

Fire location?

Persons in fire vicinity or vehicles leaving area?

Name and telephone number of caller?

Time since caller saw fire to time of call?

Fire near or threatening homes?

Anyone fighting the fire?

Fire size?

Type of vegetation burning?

Fire behavior (running, direction, etc)?

Color of smoke?

2. Notify personnel in the following order as needed.

Names	Phone Numbers
Michael Stroeh, Project Leader Coastal Delaware NWR Complex	Office 302-684-8419
Annabella Larsen, Refuge Biologist	Office 302-684-8419
KellyAnn Gorman, Zone FMO Blackwater NWR	Office 410-228-2692 x 128 Cell 443-521-3921
Bill Giese, Fire Control Officer Blackwater NWR	Office 410-228-2692 x129 Cell 410-430-1782
Milton Fire Department	302-684-8121
Memorial Volunteer Fire Co. (Slaughter Beach)	302-422-8888
Allen Carter, Regional Fire Management Coordinator	Office 757-986-3409 X101 Cell 757-647-1992

3. Other contact information

Sussex County Emergency Operations Center	Emergency 911 Non-emergency 302-855-7801
Sussex County Sheriff	302-855-7830
Delaware Department of Agriculture, State Forest Service	302-698-4500
Tom Postell - Area Source Compliance Manager, Air Quality Management, Delaware Department of Natural Resources and Environmental Control (DNREC)	Office 302-739-9425 Office of Secretary 302-739-9000

## **Appendix F – Annual Refuge Fire Management Readiness Activities**

These are annual activities to maintain program integrity and currency. Responsibility for most of them lies with the Zone FMO and staff, working with the Refuge Manager.

### **October 1 – December 31**

- Update employee records in web-based Fire Qualifications System
- Meet with local VFDs and state representatives to review MOUs and AOPs
- Review and update refuge Fire Management Plan
- Prepare brief pre-season risk analysis in conjunction with local cooperators
- Prepare and submit prescribed fire plans for review and approval
- Order fire cache supplies and replacement equipment as needed.
- Obtain necessary physical fitness testing
- Provide updates or changes for local and regional mobilization plans.
- Refuge Manager review fuel break status and values to protect.
- Check operation of all power equipment
- Outfit field vehicles, firefighters, and interagency crew participants
- Review procedures for using emergency accounts
- Evaluate needs for refresher and firefighter training

### **March 1 – May 15 and September 15 - November 15**

- Maintain readiness as identified in the Step-Up Plan (Appendix D)

## Appendix G – Equipment and Cache

Firefighting supplies have accumulated gradually over the years, but the inventory needs to be re-evaluated in light of staff changes and the shortage of fire-qualified personnel. Knowledgeable fire staff from Blackwater NWR or the Regional Fire Management Office should assist Refuge staff in determining which of the following items should be retained, replaced, moved to a different location, or disposed of. The list below is simply an inventory of items on hand as of April 2008 and is not meant to suggest a recommended cache stocking level.

### FIRE CACHE 4/08

#### FIRE SHED

- Pump-18HP Twin Vanguard w/ fuel tank
- Fire Rake-2
- Flapper-3
- Hose reel-empty- Aluminum
- Used reel
- Slip-on pump unit w/ hose (may be unusable) Wajax Pacific-with 200' 1" booster hose
- Hose-1 ½ inch (?) length (?)
- Suction hose 2" -5' with clamp on each end-2"
- Drafting hose-2"-50'
- Forestry hose- in bag -2- 100' by 1" and 100' of ½ inch hose
- Forestry hose-in bag- 1" – 100' with adapter for 1"
- Forestry hose 2 rolls of 1" and one roll 2" hose
- Roll rubberized hose- 100' of ¾ " booster
- Drip torch holders-4 each
  - 1 1/2 " booster hose 15-20' in length
- Draft hose 8' with nozzle and 1 ½" quick connect
- Gated "Y" with 1 ½" reducer
- Flammable Liquid cabinet
  - Drip torches -6
  - Fuel cans-5 gallon-1
    - 2 ½ gallon- 2
- Foot locker #1- wool blanket-1
- 60 second tents-2
- Foot locker # 2
  - Fire shirts-yellow-small-3
    - Large-3
  - Fire Pants-green-32X?-1
    - 38X34-1
    - 36X34-1
    - 36X?-1
    - 38X?-2
  - Duffle Bag-1
  - Flight Suit-OD-36S-3
  - Flight Suit-OD- 48R-1

#### FIRE TRAILER

- Pump-Honda WH15X w/ foam inductor
- Pump-Honda WMP20X
- Sign-Smoke on Road-with stands-3
- Hearing protection-foam-I box

Cabinet drawer 1-

- Goggles-5 pr (plus 12 and 6 replacement lenses in cabinet drawer 3)
- Chaps-one pair
- Plug wrench

Cabinet drawer 2

- Fire shelter-old type 2\*\* plus-1;
- Chest harness for fire shelter
- Water bottles with cover-5
- Canteen cover-1
- First aid sting refill-1 box
- Individual first aid kits-10
- Canteen holder w/ belts- 2

Cabinet drawer 3

- Goggles- 12
- Replacement lens-goggles-6
- Headlamps-red clip-on-5 (no batteries)
- Canteen-2 quart- 2
- Canteen 1 gallon-2

Cabinet drawer 4

- One case MRE
- Nylon bags-6

Cabinet drawer 5

- Hardhats-2
- Hose-100' of ¾" neoprene hose
- 1" neoprene hose 20' with nozzle
- Hose-Forestry yellow- 1 ½' by 50'-7 rolls
- Hose wrench-long 2
- Short-2
- Knapsack hose sets- 200' of 1" with nozzle and 2 spanner wrenches- 3
- Knapsack hose set-300' of 1" nozzle and 2 spanner wrenches-2
- Knapsack-1
- Roll of white forestry hose- ¾" by 50' each
- Brass filler pipe?-1
- Box of assorted flagging- 20 rolls?
- Box of assorted chemical lights (calumes)-about 20
- Head lamps-5
- Funnel-4
- Nomex shrouds-10
- Radio chest harness-1
- Orange flags-4
- White hose (see \*\*\*\* above)- 15 additional rolls
- Safety Vests-8
- Leather gloves-14 assorted sizes
- Foam nozzle
- Misc. nozzles and connectors- number ?
- "Y" connectors with shut offs-3-gated "Y"
- Assorted connectors
  - Pressure relief valve=1 ½' -6
  - "T" 1 ½"-6
  - "T" 1"- 2
  - Coupling- thread NH-NPSH

3/4" "Y"- 2  
3/4" ball cock- 12  
Hose gaskets-bag  
Foam-30 gallons  
Hose-2" – 2- length unk.  
Flares-fussees-20  
Liner for back pack pump-2  
Fire coat w/ liner-XL-1  
Coveralls-LT-5  
Coveralls –XLT-3  
Traffic cones-large-3  
Bolt cutter-1  
Backpack pump-2  
Fire rakes-13 (plus 2 in fire shed)  
Shovels-6  
Truck mount for drip torches-4  
Flappers-6 (plus 3 in fire shed)  
Safety axe-1  
Hose clamps-2  
Hose wrench-4 large and 4 small  
Ropes with clamps- 5 sets- 3-10'; 1-25'; 1-50'  
Soaking wands- 5  
Hydrant wrench  
Energy stream lights-4  
Halogen light

#### **SHOP**

Shelters-old- 4 (with shelters in fire trailer-total = 7 (taken to trailer) not including shelters on personal gear (4)

Fire pants-30X30-2  
32X34-1  
Reducers /connectors-1"-1/2' and 2" to B both quick connect and quick connect cap  
Main pack-used-1  
2" DC connector  
Pants women's size 12  
Hose bag  
Deluge set up- 1 1/2"  
Foam inductor and hose for foam inductor

**OFFICE**-upstairs-sleeping bag-1

## Appendix H – Radio Frequencies

The following frequencies are to be used for wildland fire radio communications at Prime Hook NWR

SYSTEM	RX FREQ.	RX TONE	TX FREQ.	TX TONE	ASSIGNMENT	REMARKS
Local	800 MHz		800 MHz		Tactical	

All crews will have at least 1 radio or be teamed with a person with a radio.

During prescribed fires, a cell phone will be on site and with the Burn Boss or Deputy, and numbers will be provided in the pre-burn briefing



## **Appendix I – Agreements**

All the versions of the agreements included in the plan are currently outdated documents which are no longer in effect, but which may serve as a template for updating in the near future.

Cooperative Fire Control Agreement between Delaware Department of Agriculture, Resource Management Unit/Forestry and the Department of the Interior, U.S. Fish and Wildlife Service

Fire Control Cooperative Agreement between the Prime Hook National Wildlife Refuge U.S. Department of the Interior Fish and Wildlife Service and the Milton Fire Department, Inc.  
(14-16-0005-85-9017)

Fire Control Cooperative Agreement between the Prime Hook National Wildlife Refuge U.S. Department of the Interior Fish and Wildlife Service and the Memorial Volunteer Fire Co. (Slaughter Beach) (14-16-0005-87-9003)

COOPERATIVE FIRE CONTROL AGREEMENT  
Between  
DELAWARE DEPARTMENT OF AGRICULTURE  
RESOURCE MANAGEMENT UNIT/FORESTRY  
And the  
DEPARTMENT OF INTERIOR  
U.S. FISH AND WILDLIFE SERVICE

This Cooperative Agreement between the U.S. Fish and Wildlife Service, hereinafter referred to as the "Service," and the Delaware Department of Agriculture, Forestry Section, referred to as the "Department," is hereby entered into under the authority of the Fire Protection Act of May 27, 1955 (USC 1856). This Agreement is to facilitate the cooperation of the two parties in the conduct of wildfire prevention, detection, and suppression designed to protect lands under the jurisdiction of each. This agreement provides for the limited exchange of personnel, equipment, facilities, and funds to obtain this goal.

WITNESSETH

WHEREAS, responsibility for prevention and control of forest fires on State and/or Private lands rests with the Department, and for National Wildlife Refuge land, with the Service. Each agency maintains separate organizations for these purposes, and

WHEREAS, the Service maintains prevention, detection, and suppression forces throughout the National Wildlife Refuges, covering areas adjacent to lands which the Department protects. The Department maintains prevention, detection, and suppression forces to protect areas of State and Private lands in counties and cities of the State of Delaware, in which are intermingled areas of National Wildlife Refuge land, and

WHEREAS, it is to the mutual advantage of both the Department and the Service to coordinate their efforts in the prevention, detection, and suppression of wildland fires in and adjacent to their areas of responsibility, without duplication and

WHEREAS, it will be mutually beneficial for the parties hereto to furnish reciprocal or cooperative fire protection services for each other, and

WHEREAS, it is the intent of the parties hereto that Department firefighters be allowed to assist in the suppression of wildfires on all in-state National Wildlife Refuges, and

WHEREAS, it is the intent of the parties hereto that Service firefighters be allowed to assist in the suppression of wildfires on all State and Private lands which the Department is committed to protect in the State of Delaware,

NOW, THEREFORE, in consideration of the above premises, the parties hereto agree as follows:

I. DEFINITION OF TERMS

a. Reciprocal Fire Protection Services shall mean non-reimbursable fire protection assistance, extended by either party to lands of the other party, as each may be in a position to furnish. These lands are described and shown in the Annual Action Plan.

b. Reimbursable Work shall mean reinforcements exceeding reciprocal fire protection services furnished by either party, at the request of the other, or fire protection furnished as a chargeable cooperative fire protection service.

c. First 23 hours shall mean the period of fire suppression from the time of the first actual attack on the fire to 24-hours hence.

d. Initial Attack Forces are the first forces (air and/or ground) that take fire suppression efforts on a fire, including normal reinforcements used to control a fire in continuation of initial attack.

e. Reinforcements are all additional personnel and equipment needed to facilitate suppression action after initial attack (refer to definition of Initial Attack Forces regarding normal initial attack reinforcements.)

f. Direct costs are those costs directly related to the suppression efforts. These costs are not to include dispatch or other administrative costs.

g. Time of Departure is the time of the start of the employment period, beginning at the point and time individuals make themselves available for hire or work, at the request of a Fire Officer.

h. Return to Official Station is the time the employee is returned to the point of hire, or is no longer available.

i. Boundary Fires shall mean fires that burn on adjoining lands of both parties or threaten to burn across fire protection boundaries. This includes the situation where the actual location of the fire protection boundary is uncertain.

j. Cooperative Fire Protection Services shall mean providing specific service or fire protection responsibility on a reimbursable basis, pursuant to an Annual Action Plan.

k. Annual Action Plan is a document that provides detailed information pertinent to wildfire suppression readiness including maps showing Department and Service boundaries, fire protection organizations of each party, protection and firefighting facilities, and details of reimbursement and non-reimbursement costs and services. Other items may be added as mutually agreed upon by

both parties. The Plan will be updated and reviewed annually by representatives of the Department and the Service.

## II. RECIPROCAL FIRE PROTECTION

### A. The Service may:

1. Make initial attack on fires on those Department-protected lands which are adjacent to Service lands, and identified in the Annual Action Plan.

### B. The Department will:

1. Make initial attack on fires on those Service-protected lands which are identified in the Annual Action Plan.

### C. Both parties agree:

1. The receiving party will not be required to reimburse the assisting party for its costs within the first 24-hour period

2. The receiving party will reimburse the assisting party for all costs incurred by the assisting party for reinforcements and services furnished beyond the initial attack force during the first 24-hour period, and for all costs for the service of both the initial attack force and reinforcements incurred beyond the first 24-hour period in accordance with Section III of this agreement.

3. Each of the parties to this agreement do hereby expressly waive all claims against the other party for compensation for any loss, damage, personal injury or death occurring in consequence of performance under this section of this agreement.

## III. COOPERATIVE FIRE PROTECTION (REIMBURSABLE)

### A. The Service will:

1. Furnish personnel and firefighting equipment to the Department at the request of an authorized Department officer. Such assistance will be sent provided that the fire danger and risks are such that personnel and equipment may be safely released, and that other Service operations will not be adversely affected. All such efforts shall be reimbursed by the Department, as provided for in the Annual Action Plan.

### B. The Department will:

1. Furnish personnel and firefighting equipment to the Service at the request of an authorized Service officer. Such assistance will be sent provided that the fire danger and risks are such that personnel and equipment may be safely released, and that other Service operations will not be

adversely affected. All such efforts shall be reimbursed by the Service, as provided for in the Annual Action Plan.

Both parties agree:

1. The Annual Action Plan will cover reimbursable services to be furnished by each agency. It will provide that equipment rental, salary and wage costs of personnel assigned to fire suppression shall be at the actual cost of the sending agency. The Action Plan will clearly indicate the equipment rental and personnel wage rates to be charged by each agency.
2. Payments for reimbursable services under this agreement will be made within 60 days of receipt of an itemized statement. Reimbursements to the Service shall be made payable to: State of Delaware Department of Agriculture.
3. When one party performs work or otherwise incurs expenses for which the other party is responsible, the officers in charge shall reach agreements as to the specific work to be performed while on the ground.
4. No reimbursable expenditures in excess of \$5,000 shall be incurred without expressed authority of the individuals designated to this responsibility in the Annual Action Plan.
5. When Service personnel are fighting fires on lands for which the Department is responsible, the United States of America shall not be liable to the Department or any land owner for any damage in consequence of the performance of work under this section of the agreement. This clause shall not be construed to constitute an agreement by the Department to indemnify or save and hold the United States harmless from any claims for damages resulting from work performed under this section of this agreement.

#### IV. MISCELLANEOUS CONDITIONS

1. Annually, no later than September 1, the parties hereto will meet and develop an Annual Action Plan in writing, which will be attached hereto and made a part hereof.
2. Either party may terminate this agreement by providing 60 days written notice to the other. Unless terminated by written notice, this agreement will remain in force for a period of five years from final signature, whereupon it may be reviewed for renewal.
3. Either party will notify the other, in advance, of prescribed burning operations.
4. Each agency will be responsible for the training of their respective fire organizations and will invite appropriate representatives of the other agency to attend and participate in training meetings, for the purpose of promoting closer working relations and better acquaintance with the fire organizations.
5. Fire prevention and law enforcement efforts will be coordinated to the maximum extent

possible, at all levels of both agencies, especially at the Refuge Manager and Department Regional Forester level.

6. Each agency will render mutual assistance in fire law enforcement activities and the gathering of evidence, and in actual court prosecutions to the fullest extent possible. The Service will be responsible for law enforcement on fires originated on and confined to National Wildlife Refuge land. The Department will be responsible for law enforcement on fires that originate and are confined to Private and Department land on which it takes sole action. On fires burning on both National Wildlife Refuge and State and Private land, any law enforcement action shall be agreed to between the Refuge Manager and the Department Forester or their representatives.

7. Both agencies will furnish each other, or otherwise make available upon request such maps, documents, instructions, records, and reports including, but not limited to fire reports and law enforcement reports, which either party considers necessary in connection with this agreement, subject to the United States Department of Interior and the State of Delaware rules and regulations.

8. Each agency may install and maintain radio equipment in the other agency's facilities without charge, as provided for in the Annual Action Plan.

9. Each agency, when suppressing fires for the other agency, will adhere to the suppression and mop-up standards of the receiving agency insofar as facilities and manpower are available. If adequate facilities and manpower are not available to meet standards, the sending agency will notify the other agency at the earliest possible time.

10. Lookouts and other employees of either agency shall, upon discovering or receiving reports of fires on areas protected by the other agency, report such fires promptly to the Annual Action Plan.

11. In the event both agencies are engaged on a fire at or near the boundary of land each is responsible for protecting, the line officers of each agency shall mutually agree upon the fire control strategy with the areas and lines of separate suppression responsibility conforming as much as practicable to the respective areas of protection responsibility. Agencies will agree immediately upon the position of Incident Commander. The Incident Commander, with his fire overhead organization, will be responsible for tactical decisions.

12. When the Department suppresses fires wholly or in part on National Wildlife Refuge lands, the necessary fire report data will be forwarded to the responsible Refuge Manager. The Refuge Manager will report to the Department Regional Forester all fires on State and Private land suppressed by the Service for inclusion in the Department's Annual Clarke-McNary Report. These reports will be forwarded with estimates of all costs involved.

13. Personnel dispatched by either agency for the benefit of the other agency under the terms of this Agreement will be considered as employees of the sending agency, and shall not be considered to be agents of the agency receiving assistance, and the said sending agency shall be

responsible for the welfare of such personnel, including the treatment of any injuries which may result from, or be incurred enroute to or on any fire, as provided by the laws and regulations under which each agency operates.

14. Equipment owned and used by either agency to suppress fires on lands for which the other is responsible will normally be operated, serviced, and repaired by the owning agency. Exceptions to this practice, when needed, will be agreed to, in writing, by both parties in advance.

15. Each party will be responsible for damage to its equipment under its laws and rules, except that if equipment is rented without operators, the receiving agency will be responsible under applicable laws of the agency and signed rental agreement. Equipment will be inspected before and after use, and damage claims submitted for charge to the incident.

16. The salary or wages of personnel shall be at the actual cost to the sending agency for work time from the time of departure until return to the official station, including overtime, if and when overtime is earned, under the laws or rules governing the employees of the sending agency.

17. The Department shall not be bound to make any expenditures under the terms of this agreement, except as funds as appropriated by the legislature of the State of Delaware. Nothing herein contained shall be construed as binding to Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or administratively allocated for the purpose of this Agreement for the fiscal year, or to involve the Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

18. When either party requests reimbursable assistance from the other, the sending agency will dispatch only personnel who meet or exceed the minimum requirements for the training and physical standards of the Incident Command System.

19. No member of, or delegate to Congress or Resident Commissioner shall be admitted to any share or part of this Agreement, or to any benefit to arise there from; but, this provision shall not be construed to extend to this Agreement if made with a corporation for its general benefit.

20. All aircraft and pilots used to transport Service personnel or directly controlled by U.S. Fish and Wildlife shall be certified by a qualified Office of Aircraft Services inspector prior to Service use.

21. By accepting this Agreement, the Department hereby agrees to comply with Title VI of the Civil Rights Act of 1964, and all requirements imposed by or pursuant to the regulations of the United States Department of Interior issued pursuant to that Act, and hereby assures that in the operation and performance of this Agreement to take immediately any measures necessary to effectuate this requirement. The Department further agrees that the United States, in addition to any other rights and remedies provided by this assurance, the Civil Rights Act of 1964, or the regulations issued there under, shall have the right to enforce this Agreement by suit issued there under, for specific performance of by any State in which the breach of violation occurs.

IN WITNESS WHEREOF, the parties hereto have executed this agreement on the last date of signature.

FISH AND WILDLIFE SERVICE, U.S. DEPARTMENT OF INTERIOR

/s/ Thomas J. Dwyer  
Regional Director, Region 5  
Ronald Lambertson

8/17/93  
Date

STATE OF DELAWARE, DEPARTMENT OF AGRICULTURE

/s/ John F. Tarburton  
Secretary of Agriculture  
John Tarburton

9/10/93  
Date



FIRE CONTROL COOPERATIVE AGREEMENT  
BETWEEN THE  
PRIME HOOK NATIONAL WILDLIFE REFUGE  
U.S. DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
AND THE  
MILTON FIRE DEPARTMENT, INC.

THIS AGREEMENT is made by and between the Milton Fire Department, Inc. and the U.S. Fish and Wildlife Service, under the authority of "The Protection Act of September 20, 1922" (42 Stat. 857; U.S.C. 594), the "Reciprocal Fire Protection Act of May 27, 1955" (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b) and the corporation "By-laws of Milton Fire Department, Inc."

WITNESSETH:

WHEREAS, the U.S. Fish and Wildlife Service (hereinafter the "Service") is the agency of the Federal Government primarily responsible for welfare and protection of lands and wildlife within the boundaries of the Prime Hook National Refuge (hereinafter the "Refuge") and

WHEREAS, it is the desire of the Service to provide maximum protection of the refuge, its lands, wildlife, personnel, and facilities from fire; and

WHEREAS, it is the desire of the Milton Fire Department, Inc., (hereinafter referred to as the "Fire Department") to provide protection for its lands, citizens, and buildings within the fire district from fire and

WHEREAS, Milton Fire Department, Inc., is a volunteer company whose subsistence is dependent upon annual contributions from the fire district and minimal State funding; and

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual," of fire management is, "...to protect and enhance habitat for fish and wildlife production and diversity, and to protect and enhance natural ecosystems on these (refuge) lands." And;

WHEREAS, it is desirable for both parties to establish a cooperative agreement toward meeting the need for prevention, detection, and suppression of wildlands fires within the Prime Hook National Wildlife Refuge, provided, however, that a mutual understanding is reached between both parties on the following matters:

ARTICLE I. DEFINITIONS

1. Refuge Lands: Lands administered and/or protected by the Prime Hook National Wildlife Refuge/U.S. Fish and Wildlife Service, these lands constitute the Refuge's jurisdictional area.
2. Fire District: Lands protected by the Fire Department; these lands constitute the Fire Department's jurisdictional area.

3. Wildland Fire: A fire that burns uncontrolled in vegetation or associated flammable materials, fires principally involving structures or facilities are not included.

#### ARTICLE II. The Fire Department Agrees:

1. To provide, as is available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress wildlands fires on lands within the Refuge, under the direction of the Fire Chief or other superior officer of the Fire Department, and in cooperation with the Refuge Manager, or his designated representative.

2. To notify the Refuge when suppression equipment and personnel are not available for any wildfires on the refuge.

#### ARTICLE III. The Refuge Agrees:

1. To provide, when available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress fires on Refuge lands.

2. During suppression activities by the Fire Department of wildlands fires on lands within the Refuge, to delegate the authority to the Fire Department necessary to put the Fire Chief, or his designee, in command of the firefighting effort.

3. As conditions permit, maintain a firebreak west of the improved and developed properties adjacent to Prime Hook Beach.

#### ARTICLE IV. Meetings and Designations of Head Agency

The parties hereto shall meet at least annually, prior to April 1, to review operations and planning hereunder. It is agreed that the Refuge Manager, Prime Hook National Wildlife Refuge, shall be responsible for setting a mutually convenient date, time, and place of said meeting.

#### ARTICLE V. Special Provisions

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provided herein.

3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.

4. Copies of fire reports shall be mutually provided to the other agency(ies) involved in the fire suppression as soon as possible following the fire action.

5. The Service shall reimburse the Fire Department for actual suppression costs, as per the attached schedule, not to exceed \$1,000 per response or \$10,000 per fiscal year without further approval of the Refuge Manager.

6. A list of equipment susceptible to a liability claim is attached as part of the addendum. The Refuge Manager will be contacted by the Fire Department to assist in the filing of such a claim within thirty (30) days of the incident. Such liability does not extend to loss of life.

7. The parties hereto agree to waive any and all claims for loss, damage, personal injury, and death occurring in consequence of the performance of this agreement, except as otherwise provided herein.

8. Nothing herein contained shall be construed as binding to Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or administratively allocated for the purpose of this Agreement for the fiscal year, or to involve the Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

9. Reimbursement to the Fire Department for suppression of fires originating on the refuge and burning both on and off the refuge will be determined by prorating the total suppression costs of both parties based on the number of acres burned.

10. No member of or delegate of Congress or resident commissioner after his election or appointment, either before or after he has qualified and during his continuance in office; and no officer, agent or employee of the Federal Government shall be admitted to any share or part of this contract or agreement or to any benefit arising therefrom. The provision herein, with respect to the interest of members of or delegates to Congress and resident commissioners in this agreement shall not be construed to extend to an incorporated company where such contract or agreement is for the general benefit of such corporation.

#### ARTICLE VI. Modification and Duration

1. THIS AGREEMENT shall become effective on the last day of signing below and shall continue in effect until September 30, 1985, and shall be considered as automatically extended for one (1) year each October 1 thereafter, until terminated.

2. Each party hereto shall be obligated to submit to the other copies of any legislation or regulation hereinafter adopted which comes to the attention of that party, which in any way affects the provisions of this agreement.

3. THIS AGREEMENT may be amended by written mutual consent of the parties hereto, or may be terminated by either party giving the other at least (30) days written notice in advance; but, such termination shall not relieve either party of obligation left outstanding under the terms of this agreement.

THE MILTON FIRE DEPARTMENT, INC., MILTON, DELAWARE

/s/ unknown script  
President

DATE: 6/25/85

/s/ Lynn J. Rogers  
Chief

DATE: 6/25/85

U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE – PRIME HOOK  
NATIONAL WILDLIFE REFUGE

/s/ Wayne unknown script  
Deputy Regional Director, Region Five

DATE: 6/13/85

APPENDIX (to Milton Fire Company Agreement)  
SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Milton Fire Department, Inc. for services as listed below and paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

- A. Actual suppression activities: \$100.00/unit per hour
- B. Mop-up, overhaul, fire watch and other specifically authorized post-Suppression activities: \$70.00/ hour
- C. Rescue Equipment: \$100.00 per use

MAJOR EQUIPMENT: MILTON FIRE COMPANY, INC.

TYPE	YEAR	MAKE	DESCRIPTION	VALUE*
Fire truck	1977	Ford	750 gallon, 750 GPM	\$51,000
Pumper truck	1961	Ford La France	1000 gallon, 750 GPM	16,000
Pumper truck	1961	Ford La France	1000 gallon, 1200 GPM	16,000
Fire truck	1969	American La France	1250 gallon, 500 GPM	76,251
Fire truck	1971	American La France	1200 gallon, 500 GPM	74,000
Ambulance	1977	Chevrolet	Ambulance	42,000
Ambulance	1983	Ford	Ambulance	27,900
Rescue/command	1969	Ford	Rescue/command	40,000
Radio portable		General Electric	4 each – portable	2,000 (total)
Boat		Boston Whaler	16' 7" long	6,895

\* Equipment and Value current as of 1985

FIRE CONTROL COOPERATIVE AGREEMENT  
BETWEEN THE  
PRIME HOOK NATIONAL WILDLIFE REFUGE  
U.S. DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
AND THE  
MEMORIAL VOLUNTEER FIRE CO. (SLAUGHTER BEACH)

THIS AGREEMENT is made by and between the Memorial Volunteer Fire Co. (Slaughter Beach), and the U.S. Fish and Wildlife Service, under the authority of "The Protection Act of September 20, 1922" (42 Stat. 857; U.S.C. 594), the "Reciprocal Fire Protection Act of May 27, 1955" (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b) and the corporation "By-laws of Memorial Volunteer Fire Co."

WITNESSETH:

WHEREAS, the U.S. Fish and Wildlife Service (hereinafter the "Service") is the agency of the Federal Government primarily responsible for welfare and protection of lands and wildlife within the boundaries of the Prime Hook National Refuge (hereinafter the "Refuge") and

WHEREAS, it is the desire of the Service to provide maximum protection of the refuge, its lands, wildlife, personnel, and facilities from fire; and

WHEREAS, it is the desire of the Memorial Volunteer Fire Co., (hereinafter referred to as the "Fire Department") to provide protection for its lands, citizens, and buildings within the fire district from fire and

WHEREAS, Memorial Volunteer Fire Co., is a volunteer company whose subsistence is dependent upon annual contributions from the fire district and minimal State funding; and

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual," of fire management is, "...to protect and enhance habitat for fish and wildlife production and diversity, and to protect and enhance natural ecosystems on these (refuge) lands." And;

WHEREAS, it is desirable for both parties to establish a cooperative agreement toward meeting the need for prevention, detection, and suppression of wildlands fires within the Prime Hook National Wildlife Refuge, provided, however, that a mutual understanding is reached between both parties on the following matters:

ARTICLE I. DEFINITIONS

1. Refuge Lands: Lands administered and/or protected by the Prime Hook National Wildlife Refuge/U.S. Fish and Wildlife Service, these lands constitute the Refuge's jurisdictional area.
2. Fire District: Lands protected by the Fire Department; these lands constitute the Fire Department's jurisdictional area.

3. Wildland Fire: A fire that burns uncontrolled in vegetation or associated flammable materials, fires principally involving structures or facilities are not included.

#### ARTICLE II. The Fire Department Agrees:

1. To provide, as is available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress wildlands fires on lands within the Refuge, under the direction of the Fire Chief or other superior officer of the Fire Department, and in cooperation with the Refuge Manager, or his designated representative.

2. To notify the Refuge when suppression equipment and personnel are not available for any wildfires on the refuge.

#### ARTICLE III. The Refuge Agrees:

1. To provide, when available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress fires on Refuge lands.

2. During suppression activities by the Fire Department of wildlands fires on lands within the Refuge, to delegate the authority to the Fire Department necessary to put the Fire Chief, or his designee, in command of the firefighting effort.

3. As conditions permit, maintain a firebreak west of the improved and developed properties adjacent to Slaughter Beach.

#### ARTICLE IV. Meetings and Designations of Head Agency

The parties hereto shall meet at least annually, prior to April 1, to review operations and planning hereunder. It is agreed that the Refuge Manager, Prime Hook National Wildlife Refuge, shall be responsible for setting a mutually convenient date, time, and place of said meeting.

#### ARTICLE V. Special Provisions

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provided herein.

3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.

4. Copies of fire reports shall be mutually provided to the other agency(ies) involved in the fire suppression as soon as possible following the fire action.

5. The Service shall reimburse the Fire Department for actual suppression costs, as per the attached schedule, not to exceed \$1,000 per response or \$10,000 per fiscal year without further approval of the Refuge Manager.

6. A list of equipment susceptible to a liability claim is attached as part of the addendum. The Refuge Manager will be contacted by the Fire Department to assist in the filing of such a claim within thirty (30) days of the incident. Such liability does not extend to loss of life.

7. The parties hereto agree to waive any and all claims for loss, damage, personal injury, and death occurring in consequence of the performance of this agreement, except as otherwise provided herein..

8. Nothing herein contained shall be construed as binding to Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or administratively allocated for the purpose of this Agreement for the fiscal year, or to involve the Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

9. Reimbursement to the Fire Department for suppression of fires originating on the refuge and burning both on and off the refuge will be determined by prorating the total suppression costs of both parties based on the number of acres burned.

10. No member of or delegate of Congress or resident commissioner after his election or appointment, either before or after he has qualified and during his continuance in office; and no officer, agent or employee of the Federal Government shall be admitted to any share or part of this contract or agreement or to any benefit arising there from. The provision herein, with respect to the interest of members of or delegates to Congress and resident commissioners in this agreement shall not be construed to extend to an incorporated company where such contract or agreement is for the general benefit of such corporation.

#### ARTICLE VI. Modification and Duration

1. THIS AGREEMENT shall become effective on the last day of signing below and shall continue in effect until September 30, 1987, and shall be considered as automatically extended for one (1) year each October 1 thereafter, until terminated.

2. Each party hereto shall be obligated to submit to the other copies of any legislation or regulation hereinafter adopted which comes to the attention of that party, which in any way affects the provisions of this agreement.

3. THIS AGREEMENT may be amended by written mutual consent of the parties hereto, or may be terminated by either party giving the other at least (30) days written notice in advance; but, such termination shall not relieve either party of obligation left outstanding under the terms of this agreement

MEMORIAL VOLUNTEER FIRE CO., SLAUGHTER BEACH, DELAWARE

/s/ Harlan R. Swain, Jr.  
President

DATE: 5/12/87

/s/ Allen R. Lester  
Chief

DATE: 5/12/87

U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE – PRIME HOOK  
NATIONAL WILDLIFE REFUGE

/s/ Wayne unknown script  
Acting Regional Director, Region Five

DATE: 3/18/87

APPENDIX (to Slaughter Beach Agreement)  
SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Memorial Volunteer Fire Co. for services as listed below and paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the Station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

- A. Actual suppression activities: \$100.00/unit per hour
- B. Mop-up, overhaul, fire watch and other specifically authorized post-Suppression activities: \$70.00/ hour
- C. Rescue Equipment: \$100.00 per use.

MAJOR EQUIPMENT: MEMORIAL VOLUNTEER FIRE CO. (SLAUGHTER BEACH)

UNIT	TYPE	MAKE	DESCRIPTION	VALUE
89-1	Pumper	1980 – Hahn	1000 gallon, 1250 GPM	\$ 76,000
89-3	Brush truck	1986 – GMC	250 gallon, 60 GPM	32,000
89-4	Pumper	1961 – Ford	800 gallon, 750 GPM	15,900
89-5	Rescue	1981 – Ford	Rescue	49,000
89-6	Tanker	1979 - Poler International Truck	1200 gallon, 500 GPM	20,000
89-10	Generator	Kurtz & Root	15 KW	6,600
A-89	Ambulance	1970 – Cadillac		6,600

\* Equipment and Value current as of 1987



## **Appendix – J Delegation of Authority Example (also see Red Book Appendix H.)**

**Name** is assigned as Incident Commander of the *Incident Name, Prime Hook National Wildlife Refuge*, effective *Time and Date*.

The Incident Commander has full authority and responsibility for managing incident activities within the framework of the law and Fish and Wildlife Service policy and direction as provided by this office. Fire Management Plans, maps, and Habitat Management Plans and other appropriate documents will be provided by the Resource Advisor as requested.

**Names of Resources Advisors and contact Information** are assigned as Resource Advisors. Consult with them, the Refuge Manager, or designate when decisions involving significant natural resource impacts or trade-offs are involved unless human life and safety requires immediate action. Decisions and subsequent actions in such cases must be well documented. (The Deputy Refuge Manager, Zone Fire Management Officer, or designate may represent the Refuge Manager when he/she is not readily available.)

### **Specific Management Direction for the *Name of Incident*, in priority:**

1. Provide for firefighter and public safety.
2. As practicable, maximize use of minimal impact suppression tactics (MIST) to reduce habitat damage, while ensuring values threatened receive appropriate protection to mitigate potential impacts (See [http://www.wildfirelessons.net/documents/GB\\_MIST\\_Guidelines.pdf](http://www.wildfirelessons.net/documents/GB_MIST_Guidelines.pdf)).
3. Prior to use, obtain approval for dozers, tractors, or retardant from the Refuge Manager or designee, unless essential to the immediate preservation of life or property.

### **Standards for Incident Re-delegation Back to Refuge**

1. Complete, finalize, and close out all *Name of Incident* contracts, agreements, bills, medical problems, and equipment repairs, and re-supply orders for local fire caches.
2. Brief me or my designee on potential tort claims; provide documents and reports as needed.
3. Repair damage to roads and levees, clean and repair firelines and incident facilities.
4. Check all firelines to ensure appropriate objectives for maintaining fire control are met.
5. Map final fire perimeter by GPS and load into the Refuge's GIS Database.
6. As needed, coordinate ES & BAR planning with refuge Biologists and resource Advisors.

---

Prime Hook NWR Manager

---

Date and Time

## **Appendix K – Fire Report Forms**

## WILDLAND FIRE REPORT

### GENERAL TAB

- (1) Fire Type: \_\_\_\_\_ (7) Fire Subtype: \_\_\_\_\_  
(2) Org. Code: \_\_\_\_\_ (8) Measurement Method: \_\_\_\_\_  
(3) Fire Name: \_\_\_\_\_ (9) Ignition Owner: \_\_\_\_\_  
(4) Discovery Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (10) Ignition State: \_\_\_\_\_  
(5) County: Code: \_\_\_\_\_ (11) Ignition Cause: \_\_\_\_\_  
(6) Cong. District: \_\_\_\_\_ (12) WFSA? Yes or No  
(13) If WFSA = yes, Date: \_\_\_\_\_

- Burn State: \_\_\_\_\_ Burn Owner: \_\_\_\_\_ Burn Acres: \_\_\_\_\_  
Burn State: \_\_\_\_\_ Burn Owner: \_\_\_\_\_ Burn Acres: \_\_\_\_\_  
Burn State: \_\_\_\_\_ Burn Owner: \_\_\_\_\_ Burn Acres: \_\_\_\_\_  
(14) Burn State: \_\_\_\_\_ (15) Burn Owner: \_\_\_\_\_ (16) Burn Acres: \_\_\_\_\_

(17) Management Level: \_\_\_\_\_

(18) <u>Resource Type</u>	(19) <u>Quantity</u>	<u>Resource Type</u>	<u>Quantity</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

### Values at Risk

- (20) Type (21) Subtype  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (22) Discovery Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (23) Time: \_\_\_\_:\_\_\_\_ (24) Initial Attack Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (25) Time: \_\_\_\_:\_\_\_\_  
(26) Control Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (27) Time: \_\_\_\_:\_\_\_\_ (28) Out Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (29) Time: \_\_\_\_:\_\_\_\_

### LOCATION TAB

- (30) Latitude: \_\_\_\_\_.\_\_\_\_\_.\_\_\_\_\_ (31) Longitude: \_\_\_\_\_.\_\_\_\_\_.\_\_\_\_\_  
(32) Aspect: \_\_\_\_\_ (33) Lay of Land: \_\_\_\_\_ (34) Slope: \_\_\_\_\_  
(35) Position of Slope: \_\_\_\_\_ (36) Elevation: \_\_\_\_\_  
(37) Special Area Type: \_\_\_\_\_

### EMISSIONS TAB

- (38) Fire Danger Index: \_\_\_\_\_ (39) Value: \_\_\_\_\_

### FINAL TAB

- (40) Person Completing Form: \_\_\_\_\_ (41) Title: \_\_\_\_\_ (42) Date: \_\_\_\_/\_\_\_\_/\_\_\_\_  
(43) I.C.: \_\_\_\_\_  
(44) Narrative: \_\_\_\_\_



(36) Treatment Objective \_\_\_\_ \*

**EMISSIONS TAB**

(37) Fire Danger Index: \_\_\_\_ (38) Value: \_\_\_\_

(39) WX Station Type: \_\_\_\_ (40) Station ID: \_\_\_\_

**NFDRS Emissions** (must be completed for each fuel model)

(41) NFDRS Acres: \_\_\_\_ (42) NFDRS Fuel Model: \_\_\_\_

(43) Emissions: Complete the % Consumption for FWS acres.

Fuel Model Parameters	% Consumption
0 - 1/4"	
1/4" - 1"	
1" - 3"	
3"+	
Woody	
Herbaceous	
Duff (In)	

**FINAL TAB**

(44) Person Completing Form: \_\_\_\_ \* (45) Title: \_\_\_\_

(46) Date: \_\_\_\_ / \_\_\_\_ \* \_\_\_\_ / \_\_\_\_

(47) Burn Boss: \_\_\_\_ \*

(48) Narrative: \*

## Appendix L – Debris Burning Procedure Memorandum and Checklist



### United States Department of the Interior

FISH AND WILDLIFE SERVICE  
300 Westgate Center Drive  
Hadley, MA 01035-9589j



In Reply Refer To:  
FWS/Region 5/

#### Memorandum

To: Region 5 Refuge Managers  
Region 5 Hatchery Managers

From: Regional Chief, National Wildlife Refuge System  
Chief, Division of Hatcheries

Subject: Debris Disposal Burns

Prescribed burning of vegetation stands for habitat improvement and hazard fuel reduction is a traditional management practice that has long been used on National Wildlife Refuges, and is beginning to see some limited use on National Fish Hatcheries as well. Policies and procedures for conducting prescribed burns are established at the interagency, national, and regional levels, and are well-documented and familiar to most managers. Less familiar to most Service employees are the policy requirements and guidelines for conducting small, simple “maintenance” or “debris pile” burns typically used for disposal of construction materials or vegetative waste.

To provide some clarification and establish standard operating procedures for Region 5 field stations, the following protocol should be followed when considering the use of fire to dispose of debris. These guidelines comply with and elaborate on policy contained in Section 2.2.5 of the Service Fire Management Handbook.

1) Determine if burning the debris pile is environmentally acceptable considering local, state and EPA regulations. Combustion of environmentally hazardous materials, such as certain types of treated lumber, is not an acceptable practice on Service lands and could well be in violation of state or local air quality regulations. Even if the debris materials are “natural” vegetative waste with no chemical additives, the smoke produced by burning could be a public health and safety menace if persons with respiratory ailments are situated downwind or if highway visibility is obscured. Whenever possible, debris material should be recycled into a useable material such as wood chips, mulch, firewood, etc. When recycling is not feasible, debris materials should be transported to a landfill or appropriate area where they can be safely disposed. Consistent with Service policies regarding solid waste (561 FW 5), stations are encouraged to reduce solid waste by promoting waste reduction, reusing and recycling materials, and proper disposal.

2) If logistics or cost considerations make transportation and landfill disposal prohibitive, and there are no state or local air quality ordinances against burning, then fire may be considered as a disposal tool. All debris disposal burns must be reviewed for complexity by your Zone Fire Management Officer (FMO). This can often be handled by a single phone call or email, or the FMO may wish to see a written description or photograph of the project. In a few cases he may

actually need to visit the burn site.

**Type A** debris disposal burns would be those where burn piles are completely surrounded by non-combustible barriers such as a body of water, gravel parking lot, bare soil, or snow and there is no chance the fire could spot into nearby combustible vegetation. Burn piles are relatively small and fuels are consumed quickly. **The Project Leader will need to complete the Debris Burning Checklist (attached) which must be discussed with and approved by the Zone FMO.** FMO approval may be by signature or verbal (phone call). In these cases the FMO may decide to treat this as a simple maintenance operation and no burn plan would be required. No qualified Prescribed Burn Boss or prescribed burn crew members would need to be present, and the burn operation may proceed at the Project Leader's discretion.

**Type B** burns would be slightly more complex, but still surrounded by non-combustible barriers with no chance of escape. Examples would be large debris piles which burn more intensely than Type A, or old wooden buildings which need to be destroyed. These burns may be ideally suited as training exercises for local fire departments, who could perhaps be persuaded to burn the debris for free. **The Project Leader will need to complete the Debris Burning Checklist (attached) which must be discussed with and approved by the Zone FMO.** As in Type A, no burn plan is required and a qualified Burn Boss and crew are not necessary; however, the FMO may wish to consult closely with the Project Leader or fire department chief to ensure the operation is conducted safely

**Type C** would be the most complex of the debris disposal burns, characterized by a greater chance of escape into adjacent combustible vegetation, smoke-sensitive areas which could potentially be downwind, or large piles with high volumes of fuel producing high fire intensities. Type C burns will require that the FMO, or an individual of his choosing qualified as a Burn Boss at the appropriate complexity level, develop a Prescribed Burn Plan following the standard format in the Fire Management Handbook and reviewed and approved by the appropriate Regional Office staff. The burn will be conducted by the Burn Boss and qualified prescribed burn crew, working in support of the Project Leader. The Burn Boss and crew will most likely be detailed in from another field station or group of refuges, and costs will be covered by the Regional Fire Management Office. Project Leaders and FMOs are encouraged to anticipate Type C burns a year or more in advance so that funding can be programmed.

3) Project Leaders are encouraged to send staff members to wildland fire training so that they can participate on normal prescribed burns and on Type C debris disposal burns. The minimum required training is S-130 Basic Firefighter and S-190 Introduction to Fire Behavior, about a week long total.

Contact your Zone FMO for details on available training classes, and to schedule employees for the work capacity tests (Pack Test, Field Test) required for wildland fire operations. In addition, employees participating on wildland fire operations are required to wear the appropriate personal protective equipment (PPE) such as helmet, Nomex shirt and pants, leather boots and gloves, fire shelter, and eye and ear protection.

Your Zone FMO or Regional Fire Management Coordinator will be able to assist you in obtaining these items for your employees. Zone Fire Management Officers are as follows:

Rick Vollick, Sunhaze Meadows NWR, Old Town, Maine (Refuges and hatcheries in New England)  
Phone 207-827-6138 x 22

Mike Durfee, Wallkill River NWR, Sussex, New Jersey (Refuges and hatcheries in NY, PA, and NJ)  
Phone 973-702-7266

Tim Craig, Great Dismal Swamp NWR, Suffolk, Virginia (Refuges and hatcheries in DE, MD, VA, WV)  
Phone 757-986-3480

You can also contact Regional Fire Management Coordinator Allen Carter at 757-986-3409 x 101.

Attachment

### Debris Burning Checklist

What type of debris disposal burn is this?

\_\_\_\_\_ Type A

\_\_\_\_\_ Type B

\_\_\_\_\_ Type C

Have all other disposal alternatives been considered?

Justification:

Have state and local air quality requirements been met?

Has a burn permit been obtained through the local town or fire department, or appointed state fire warden? (Burning without a permit constitutes a violation of state fire laws subject to prosecution. Burning outside the restriction of the permit is also a violation.)

What is the reported fire danger or class day rating? (Burning permitted on low and moderate – Class Day 1 and 2 – only).

List fire suppression equipment and number of people to carry out the debris burn.

What contingency steps are in place in the event of an escape?

States generally require complete extinguishment prior to abandoning a fire site. How will you meet this requirement?

Have you contacted your Zone Fire Management Officer and discussed this?

\_\_\_\_\_  
Zone FMO Approval

\_\_\_\_\_  
Project Leader Approval



## Appendix M – Annual FMP Review Checklist

Element	Yes	No	Comment
1. Date FMP was approved _____ <ul style="list-style-type: none"> <li>Annual Review yrs 1 – 4 by Refuge Manager</li> <li>Year 5 of Plan, Contact District FMO. FMP requires revision and <b>Regional Director approval.</b></li> </ul>			
2. Will the FMP continue to adequately provide for firefighter and public safety as the first <b>priority in every fire management activity this year?</b>			
3. Does this FMP continue to support land and resource management Plans? <ul style="list-style-type: none"> <li>Completion of CCP or new habitat management plan might require more extensive FMP revision.</li> </ul>			
4. Were there any significant fire management activities from the previous year that were not <b>adequately</b> addressed within the <b>scope</b> of this FMP?			
5. Does the direction in this Plan remain economically viable given the values <b>needing protection</b> , and the costs to administer?			
6. Does this FMP continue to be based on best available science?			
7. Does the FMP provide for adequate response to wildland fire (wildfire) and prescribed fire (if applicable)? <ul style="list-style-type: none"> <li>Directories/Contact List(s) updated</li> <li>Agreements and Operating Plans current</li> <li>Staffing/equipment meet Service policy and ready</li> <li>Annual work and Prescribed Burn Plans completed</li> <li>Seasonal Assessment made <b>by</b> District FMO</li> </ul>			
8. Were there additional lands added to the refuge last year? <ul style="list-style-type: none"> <li>Total acres to amend _____</li> <li>Burnable acres _____</li> </ul>			
9. If additional lands were added, will environment compliance requirements (EA for this FMP) adequately allow for fire management program activities to be conducted if <b>appropriate?</b>			
10. Based on FMO advice, are there changes in national fire policy or direction that now conflict with direction within the FMP? <ul style="list-style-type: none"> <li>Policy changes warrant an amendment.</li> <li>Policy changes are significant – need for immediate revision.</li> <li><b>Policy changes can be incorporated within the 5-year revision.</b></li> </ul>			
11. Considering the responses above, can this FMP be amended without further review? <ul style="list-style-type: none"> <li>If yes, attach amended information, including maps. Refuge Manager approval. Notify the District FMO.</li> <li>If no, most likely the FMP and/or environmental compliance require Plan revision and Regional Director approval. Contact District FMO for assistance.</li> </ul>			

Having reviewed the FMP for calendar year \_\_\_\_\_, and addressed the questions above, I find that the Plan continues to support fire program needs (safety, resource protection, hazard fuel treatments, wildlife enhancement, and ecosystem restoration as applicable). The Plan amendments are attached, and require no further review or approval. This is the (please circle) 1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> implementation year for this Plan.

\_\_\_\_\_  
Refuge Manager

\_\_\_\_\_  
Date

## Appendix N – Wildland Urban Interface (WUI) Monitoring Plan

### I. INTRODUCTION

Common reed *Phragmites australis* (Cav.) Trin. ex Steudel (hereafter referred to as *Phragmites*) is a large perennial rhizomatous grass or reed. The name *Phragmites* is derived from the Greek word for fence, *phragma*, or hedge-dweller, in reference to its fence-like growth along streams. *Phragmites* is found on every continent except Antarctica and may have the widest distribution of any flowering plant (Tucker 1990). It is most common in and near freshwater, brackish, and salt water wetlands in the temperate zones world-wide and is very widespread in the United States. It typically grows in marshes and inhabits the marsh-upland interface where it seems to form continuous belts. (Roman et al 1984).

*Phragmites* has also been recorded in the fossil record of North America for at least 40,000 years. Paleoecological investigations have shown that *Phragmites* has been present along the Atlantic and Pacific coasts for several thousands of years (Saltonstall 2002). However, over the last 150 years its distribution and relative abundance has increased dramatically, particularly along the mid-Atlantic coast (Chamber et al 1999). The expansion of this plant is on a scale directly proportional to the level of wetland alterations imposed by humans. These include widespread environmental disturbances of wetland habitats plus the recent introduction (last 50 to 100 years) of very aggressive non-native haplotypes to the Atlantic coast along shipping channels (Saltonstall 2002). Today, the undesirable expansion of *Phragmites* on refuge has become a signature of man-made wetland alterations caused by habitat disturbances (pollution, OMWM excavations, water level management actions, and cultural eutrophication from off-refuge sources) that have accelerated the plants' proliferation within the refuge's marsh complex.

A fundamental concern regarding *Phragmites* expansion on Prime Hook's coastal marsh areas is the grave fire hazard it presents with consequent threats and potential danger to local beach communities. Another concern is the reduction of biodiversity of many native plant species that are replaced by aggressive and competitively superior exotic genotypes that have also displaced former native *Phragmites* populations (Saltonstall 2002). Commensurate with a shift to an exotic *Phragmites* monoculture is a reduction in insect, avian, and other floral and faunal assemblages, which is also undesirable.

#### **Federal Wildland Fire Policy and Wildland/Urban Interface Protection**

The wildland/urban interface is defined as the line, areas or zone where structures and other human development meet or intermingle with undeveloped wildland or natural vegetative fuels. In light of the Los Alamos fires, and in reviewing current conditions on the refuge, it became evident that wildland/urban interface fire protection and prevention required immediate attention. Past marsh management practices along with deferred funding decisions have contributed to a build-up of highly flammable *Phragmites* fuels on refuge lands adjacent to private beach communities. The result is that fire hazards and higher associated risks, as well as an increasing beach population, have augmented the wildland/urban interface fire hazard potential directly associated with refuge lands.

In recognition of these facts, a U.S. Department of Interior, National Fire Plan Wildland Urban Interface Initiative Project was submitted by Prime Hook National Wildlife Refuge staff through state partners (Delaware Forest Service/ Department of Agriculture) in 2001 and was funded for FY 2002. Initial plans call for similar funding for the next three years. Three communities (incorporated Village of Slaughter Beach, plus the unincorporated villages of Prime Hook Beach and Broadkill Beach) lie along the eastern boundary of the refuge. Combined, these communities contain about 750 homes with median values of \$300,000 each. This funding will be used to reduce fire hazards and risks associated with the refuge's current wildland/urban interface situation.

### **Hazard Description**

A large majority of these homes lie immediately adjacent to refuge wetland and upland habitats and would be directly affected by any marsh fires fueled by *Phragmites*. Vigorous vegetative reproduction of non-native *Phragmites* often forms dense, monospecific stands. Hara et al (1993) classify sparse stands as those with densities of less than 100 culms / M<sup>2</sup> and dense stands as those with densities of up to about 200 culms / M<sup>2</sup> in wet areas or up to 300 culms / M<sup>2</sup> in dry areas. Once established on refuge, *Phragmites* stands quickly develop into closed, monodominant stands, especially along upland salt marsh, impounded freshwater and brackish wetland areas and pond edges. Typically these stands are very dense on refuge and can range from 100 to 350 culms (live or dead)/ M<sup>2</sup>. Current rates of unchecked *Phragmites* proliferation (estimated at 50 to 100 ft/year) constitutes a severe fire hazard to the mentioned communities especially during the winter and early spring. Dead canes from previous years' accumulation (persisting for up to 5 years) have assembled very significant fuel loads in many areas. It is estimated that approximately 4,000 acres of *Phragmites* located on and off refuge currently pose an extreme fire hazard during each fire season at the wildland urban interface.

## **II. DESCRIPTION OF ECOLOGICAL MODEL**

The predominant habitat type on refuge is wetlands (70%). These wetlands include 4,500 acres of managed impounded marshes representing freshwater or brackish areas, and about 2,200 acres of salt marsh. On Prime Hook NWR *Phragmites* expansion has been facilitated by 3 factors: 1) water level management; 2) extensive OMWM excavations and ditching that have lowered water tables and raised marsh elevations in salt marsh habitats, and 3) extensive land-use changes increasing nutrient loads from intensive agricultural practices and extensive development surrounding refuge lands.

*Phragmites* has a broad salinity tolerance and can rapidly colonize either freshwater, brackish or salt marsh areas where it forms a monotypic stand. These stands are more extensive throughout the refuge's freshwater and brackish impounded wetlands where salinity and sulfide effects (environmental stressors) are greatly diminished. Because of these factors, the largest and densest stands are located within the refuge's Unit II and III management areas.

### **Phragmites Mapping Techniques Investigated**

The National Wetlands Inventory developed by Ecological Services-USFWS maintains a large,

active mapping program of tidal and non-tidal US Wetlands. However, identification of wetlands dominated by *Phragmites* has not been completed at the national level (Tiner 1998), nor is remote sensing information readily available by state or any other regional area. GIS related mapping efforts have also been thwarted to some extent as wetland areas occupied by *Phragmites* are very dynamic and annually changing, owing to rapid area expansion via clonal growth or area contraction due to restoration efforts. In addition, conventional ground-based vegetation monitoring techniques are severely limited because they can only cover small areas effectively. Therefore it was concluded that a localized aerial mapping effort would provide the best monitoring vehicle for large scale pre and post *Phragmites* treatments on refuge.

Recent remote sensing techniques using hyperspectral imaging have been used successfully to map out vegetation communities of a series of impounded marshes for monitoring annual vegetation responses to management practices at the Kennedy Space Center (Crawford et al 1998). Site-specific protocols which can quickly and accurately classify and map the distribution of remotely sensed vegetation types within impoundments have been developed using hyperspectral data over a multi-year time horizon. Such technological services are currently available commercially. For example, remote sensing services from an Easton, Maryland company - 3DI Technologies, Inc., contracts in supplying satellite hyperspectral images for precision vegetation monitoring. However, this aerial mapping service proved too costly. Upon request, remote sensing specialists from the University of Delaware also submitted a proposal for aerially mapping *Phragmites* on the refuge using airborne data acquired from IKONOS satellite imagery. They proposed a combination of multispectral mapping and image analysis using geo-referenced oblique photos, but it was also very expensive.

An interagency agreement with USGS - Water Resources Division Office in Dover, Delaware will provide the means for using an affordable aerial mapping technique to monitor large scale pre and post *Phragmites* treatment areas. A Kodak DCS 420 CIR camera, on loan from the USFS in Ft. Collins, Colorado will be used for this project. This color infrared digital camera provides the following features: 1) GPS interface capabilities to geo-reference imagery with position data, 2) quick turnaround of aerially acquired imagery - no film, and 3) expedite speed plus reduced cost to process a final USGS aerially mapped product with ArcMap applications for refuge project planning and monitoring purposes.

Deliverables by USGS will include: 1) digital files of raw uncontrolled color infrared imagery, 2) geo-referenced and rectified CIR imagery, 3) photo-index in form of ArcMap point shape-files, 4) ArcMap coverage of *Phragmites* stands delineated from aerial photography with a minimum *Phragmites* stand-mapping-unit size of 1 acre, 5) wall size (36"X36") refuge-wide and management unit maps depicting *Phragmites* stands superimposed on aerial photography, and 6) a refuge specific GIS-WUI analytical model using ArcMap v.8.1 to store all datasets related to the Prime Hook NWR WUI project..

### III. MANAGEMENT GOALS

The primary focus of this WUI Project is the reduction of hazardous fuels on refuge and other areas adjacent to local beach communities. Monotypic stands of *Phragmites* especially at the

wildland urban interface present unnaturally high fuel loads and will be immediately reduced. These plant communities should be restored to less hazardous, native vegetation. Herbicide applications will initially reduce *Phragmites* expansion but subsequent years will require combined treatments of mowing, burning and spraying to reduce and/or replace these stands. Replacing *Phragmites* with native vegetation will decrease fuel loads to more natural levels and address biodiversity concerns.

The WUI Project Management goal is to identify and map and then reduce and/or eliminate *Phragmites*-dominated areas that pose high-risk fire hazards at the refuge-wildlands/beach communities interface by using aerially acquired infra-red photos to identify and map the heaviest *Phragmites* stands (treatment polygons) and calculate this acreage of refuge-wide *Phragmites* coverage using a GIS model.

### **Management Objectives**

1. Remove 100 % *Phragmites* (live and dead) within a 1000 foot buffer zone west of each of the three beach communities (Slaughter, Prime Hook, and Broadkill) and along respective beach access roads.
2. Reduce and/or eliminate *Phragmites* cover, height, density and litter depths (fuel loads) in remaining identified treatment polygons.

Mapping and landscape analysis will be done within a GIS using ArcMap v. 8.1. Working maps will be produced delineating pre-treatment *Phragmites* stand areas, pre-treatment herbicidal plots, and recorded aerial spray lines of applied herbicide using AgNav software. GIS maps will also be used for reference to randomly select transects and navigation points for monitoring plot locations, and designing burn blocks for prescribed fire program in FY 2003.

## **IV. MONITORING DESIGN**

A viable monitoring design shall include relevant local and refuge specific conditions that will optimize available resources (time, funding, personnel and logistics) with the quality and quantity of data required to accomplish sampling objectives. The refuge sampling environmental constraints include: 1.) a very large area (4,000 + acres), 2.) major accessibility issues and 3.) travel capabilities across the refuge landscape is often very difficult and restrictive. Since this WUI Project is on a very fast timeline, sampling intensity will be limited with data containing poor estimates of variability, but still providing defensible numbers needed to assess the achievement of project goals and objectives.

### **A. Monitoring Goal**

To evaluate *Phragmites* response to herbicide and prescribed fire treatments by monitoring *Phragmites* density and cover changes. Also to record subsequent pioneering plant species occurrences where *Phragmites* may be eliminated and any other changes within wetland and upland vegetation communities.

## B. Sampling Design and Field Measurements

Changes in *Phragmites* cover, height and density will be important in assessing the success of hazard fuel control treatments for this WUI project. Since plant heights in general of greater than 50 % of the vegetation in hazardous fuel areas are greater than 3 feet, a line intercept method will be used to sample within stand variation and quantify changes in plant community cover and height over time. Along each transect the following data will be collected:

1. archival ground-level digital photographs,
2. percent frequency of the following vegetation classes (*Phragmites* > 2.0 meters tall; *Phragmites* < 2.0 meters; annual plants; perennial plants; dead vegetation; bare ground/water category) at 1-meter intervals,
3. 10 measurements of litter depth per transect, and
4. four 1-m<sup>2</sup> quadrats to record dominant plant species, measure *Phragmites* density (stems/M<sup>2</sup>), and average and tallest *Phragmites* plant heights.

Protocols for specific field measurements can be found in the appendix of this plan.

Frequency estimates will be used to describe plant abundance and distribution and will be a useful tool to detect change within *Phragmites* areas over time. A reasonable sensitivity to changes in frequency values between 30 to 70% can be detected, however shifts in frequency values can often result from changes in cover, density, or pattern of distribution. For this reason it has also been recommended to collect cover and density data along with frequency data. (Elzinga et al. 1998)

Dominant species and cover data will be measured using randomly selected meter square quadrat locations along each transect. Also within these same quadrat plots, the height of the tallest *Phragmites* plant and the height of an average plant will be measured. Although the average values calculated by measuring every plant within the quadrat would be more accurate, the time required to collect *Phragmites*-specific data at each quadrat for every *Phragmites* plant would be greatly increased.

On the other hand, obtaining an average height measurement from a single plant, allows a larger number of quadrat samples to be collected per unit time. This proposed method permits sampling across a greater portion of each transect, which will provide results that are more representative of average *Phragmites* plant heights within designated treatment polygons. Annual assessments will document changes in height and density of *Phragmites* plus any change in the abundance of other plant species over time. This designed sampling regime will also document the efficacy of treatments (herbicide, mowing, and fire) and identify the need for additional treatments if necessary. It will also provide information for judging the relative success or failure of the WUI project's goal of reducing hazardous *Phragmites* fuel loads.

Random sampling locations will be picked within defined GIS treatment polygons. About 45 permanent transects will be established where the following field measurements will be taken for the next three years.

### C. Sampling Objectives:

1. Map the expansion/contraction and/or elimination of *Phragmites* refuge-wide over three years using aerially acquired infra-red photography and GIS analysis techniques.

2. Randomly locate 45 sample plots (50 meter-long transects) throughout delineated *Phragmites* polygons to provide quantitative data to monitor:

i - Phragmites Mortality Trends with multiple year comparisons of frequency and presence/absence data.

ii - Fuel Loading comparisons via litter depth, *Phragmites* stand height and stand density (# stems/M<sup>2</sup>) measurements.

iii - Vegetation Succession with percent cover and plant species composition assessments in meter square quadrats within transects (four per transect).

*Phragmites* polygons will be delineated and digitized from false color Infra-red digital imagery and field reconnoitered for each refuge management unit using Arc/Info. These polygons will be inside-buffered to fifty meters and a chord will be struck along the longitudinal axis of each *Phragmites* polygon. Each chord will then be divided into fifty-meter segments and lines perpendicular to them will be drawn to outer polygon edges at each chord segment. Transect lines will then be drawn from the *Phragmites*' polygon outer edge to outer edge.

Arc/Info will then assign each transect line topological identifiers called nodes, and each node will be assigned a unique management unit number. A random number table program will then be used to locate start and end points along each GIS transect. All points will then be uploaded to a commercial GPS so field workers can locate monitoring transects on the ground.

### D. Timing of Monitoring

After the initial year, subsequent aerial color infrared photography will be acquired for comparative analysis before June 15<sup>th</sup> of the growing season. Quantitative "die-off" or "*Phragmites* control" attributes will be assessed at the start of each growing season and by comparing ground field measurements within years to evaluate the success or failure of control treatments. Field data will be collected between September 1<sup>st</sup> and October 15<sup>th</sup>.

## IV. DATA ANALYSIS AND INFORMATION MANAGEMENT

Raw data sheets will be stored in the biologist's office. Field data collected will be entered into Microsoft Access spreadsheet for frequency, litter depth, stem density and plant height. Areal cover data will be entered into the Regional Vegdata program that will calculate percent cover and frequency of plant species recorded at each sampled quadrat plot. Electronic data will be stored on the biologist's computer in the form of an Access Database file named as WUI Transect Monitoring and also in the Vegdata database. All monitoring data will also be exported into an ArcMap WUI-GIS model to summarize field data and enhance planning activities for subsequent years.

## V. MANAGEMENT IMPLICATIONS FOR PHRAGMITES CONTROL

New genetic markers (primer pairs for amplification of noncoding regions in POACEAE chloroplast DNA) have provided detailed understanding of *P. australis* population biology, dynamics and distribution of native and non-native haplotypes (Saltonstall - 2002). Recent field studies have also catalogued observable morphological differences between native and introduced haplotypes (Saltonstall-2002). Based on these studies it may be likely that small pockets of native *Phragmites* may be present on the refuge but the majority of contiguous tall stands is probably the non-native M-haplotype. However, to accomplish the management objectives of this project no distinction will be made between native and non-native populations of *Phragmites*, at this time, as this would only complicate efforts to control its spread in identified buffer zones.

The biggest problem of fuel overloading occurs in the refuge's freshwater areas, followed by salt marsh areas. Salinity ranges tend to be very low within the refuge's salt marshes as tidal flow from the Delaware Bay through the Mispillion Inlet is greatly attenuated. In such a situation it is impossible to decrease *Phragmites* growth via salinity stressing. Furthermore, in the 5 to 10 ppt range, *Phragmites* has a competitive advantage over other upland marsh species like *Iva frutescens*, *Baccharis hamifolia*, *Solidago sempervirens*, etc., (Meyerson et al 2000). These environmental conditions coupled with 15 years of extensive OMWM excavations in refuge salt marsh areas has resulted in the proliferation of extensive non-native *Phragmites* stands immediately adjacent to beach homes. It is recommended that no further OMWM work be conducted on refuge to curtail these negative vegetative changes.

Reducing *Phragmites* biomass with fire in conjunction with other control activities will also require special planning. Ailstock et al (2001) compared two treatments in *Phragmites*-dominated sites: glyphosate application alone (in October), and glyphosate application (October) followed by dormant-season burning. These researchers found that burning favored a more rapid re-establishment of other marsh vegetation, with increases in species abundance and diversity: "these treatments thus appear capable of returning *Phragmites* dominated wetlands to a pre-colonization condition for 2 to 3 years. After the third growing season, expansion of *Phragmites* not killed in the initial application was significant. Therefore, additional spot applications of herbicide are needed to prevent re-growth of *Phragmites* in the long term.....burning does favor the rapid re-establishment of non-target vegetation and likely restores habitat and wetland functions."

Other studies have indicated that summer burning, in contrast to spring and fall, resulted in stunted shoot growth and was recommended for controlling vegetative growth of *Phragmites* plants (Thompson & Shay-1984). Burning in mid-summer created the greatest disruptions to the plant's growth cycle. This information could provide optimal burn-windows when planning prescribed fire actions in conjunction with herbicide applications.

For the duration of the project, annual assessments of control techniques will fine-tune prescribed management actions (mowing, spraying and timing of prescribed burns) for the following year. After collecting three years of *Phragmites* response data to spraying, burning and/or mowing regimes, empirically derived values for setting thresholds of localized *Phragmites*



growth characteristics will be determined for limited tolerance and buffer zones. This will provide quantitative "control criteria" for long term planning of *Phragmites*' management activities and monitoring.

## VI. LITERATURE CITED

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## WUI (Wildland Urban Interface) Monitoring Protocol

### VEGETATION SAMPLING FIELD METHODS

FORM A: Vegetation Transect Photographs

FORM B: Vegetation Sampling: Percent Frequency & Litter Depth

FORM C: Vegetation Sampling: Dominant Species/*Phragmites* Density and Height

Random sampling locations will be located within defined GIS treatment polygons. Within designated areas of heavy *Phragmites* infestation, permanent vegetation sampling transects will be established and several measurements will be recorded for the next three years. These will include archival digital photographs for each transect (Form A), percent frequency and litter depth (Form B), and dominant species, *Phragmites* density (number of living *Phragmites* stems/ square meter quadrat), plus average and tallest *Phragmites* plant heights (Form C). Permanent vegetation plot studies are the most direct way to monitor changes. Permanent plots allow the application of statistical tests for detecting change and are more efficient to resample than temporary plots plus fewer numbers of plots are required to detect change or track trends (Elzinga et al 1998).

Percent frequency measurements will be conducted using a point-intercept technique. This technique has a sound theoretical basis as the proportion of points intercepted equals the percent cover of that species. It is also considered to be the least biased and most objective method to obtain percent cover estimates. (Elzinga 1998) The point-intercept method uses a narrow diameter pole placed at systematic intervals along line transects to sample stand variation and quantify statistically valid changes in plant species cover and height over time. Percent frequency will be calculated as the number of “hits” for each vegetation category type divided by the total number of points per transect. A “hit” is defined as the pole touching a plant species or the ground cover class at each location.

Dominant plant species techniques will provide quantitative data on changes in plant species composition and relative abundance. Four 1-m<sup>2</sup> plots will be randomly located along each transect. Within each 1-m<sup>2</sup> plot the percent cover of each species present will be ranked by visual inspection using Daubenmire cover classes: (A: 0-5%), (B: 5-25%), (C: 25-50%), (D: 50-75%), (E: 75-95%), and (F: 95-100%). Ideally, using the same team of field observers each year will reduce any bias associated with the subjective assessment of vegetation cover.

#### Protocol A - Vegetation Sampling: Archival Photographs - Form A

**Goal:** To visually characterize each transect.

**Personnel:** A team of two people.

**Equipment:** A digital camera, Robel pole, and sight pole.

**Sampling Steps:** Place Robel pole to anchor the 50 meter tape at the designated origin or start point for each random transect location. Place the sight pole 180° from the origin.

Before taking any other vegetation measurements, use the digital camera to take a single photo of

the undisturbed vegetation in the transect from a height of one meter alongside the sight pole, shooting toward the Robel pole. (Take care not to include the sight pole in the photograph).

Record the vegetation transect sample origin data (UTM coordinates, Northing and Easting of start point, compass bearing, transect number and date) on Form A.

### **Protocol B - Vegetation Sampling: Percent Frequency and Litter Depth**

**Goal:** Use the point-intercept method to determine the % frequency of plant species occurrences to assess changes in plant community composition over time. The method uses a narrow diameter pole placed at systematic intervals along line transects to sample within stand variation.

**Personnel:** A team of two.

**Equipment:** Field tape measurement (minimum 50 meter), a stake to anchor the far end of tape, a 4 mm diameter metal rod (about 2 m long), GPS unit, plastic ruler, a trowel, and white meter stick to measure litter.

#### **Steps for Sampling Percent Frequency:**

Anchor the 50 meter end of field tape after navigating by GPS to the origin of the transect line.

Record the transect number (Refuge Management Unit I, II, III or IV, plus assigned number from the GIS sampling grid). Record both the start and end points (northings and eastings) for each transect.

Sample at fifty points spaced at one meter intervals along the transect. Place the metal rod directly adjacent to the field tape meter mark, perpendicular to the ground.

Determine all the vegetation types that touch the metal rod. Record the presence or absence of interceptions with a tick mark for each vegetation category: *Phragmites* < 2.0 meters; *Phragmites* > 2 meters; annual vegetation; perennial vegetation; dead vegetation, and water/bare ground.

A particular vegetation category is counted as intercepting the rod only once per point, no matter how many plants from that category intercept the rod, as this is a frequency measure and not dominance measure. Record all interceptions with tally marks on Data Form B. (Included with the data sheet is a field list of common annual and perennial refuge plants.)

#### **Steps for Sampling Litter Depth:**

Litter depth measurements will be taken at 10 locations along the 50 meter transect. Measure the litter depth to the nearest cm at designated points. Work through litter layers with the trowel until the soil is located at the bottom of the profile. It is important not to disturb the profile by compacting it on successive scrapes. The profile that is exposed should then allow an accurate measurement of litter depth.

Use a plastic ruler (or white meter stick) to measure the total depth of the litter profile to the nearest centimeter.

Where the rod touches the ground, note whether the ground is totally bare (or water in wet marsh habitats) as opposed to being covered by litter. This should be a visual estimate made from above. Do not move vegetation aside to determine this. If the ground is bare, record a tally mark in the appropriate data column.

#### **Protocol C - Vegetation Sampling: Dominant Species, Phragmites Density and Height**

**Goal:** To determine the dominant plant species, the number of living Phragmites stems (density), and height of the tallest and average Phragmites plant/s at sampling points along the transect.

**Personnel:** A team of 2.

**Equipment:** 1- meter<sup>2</sup> Frame, zip-lock bags (gallon) sized, and a table of random numbers (1 thru 50). Unique sets of 4 numbers per set ranging from 1 to 50 can easily be obtained from the Web Site, "Research Randomizer", ([www.randomizer.org](http://www.randomizer.org)) to select 4 quadrat locations per transect.

#### **Sampling Steps:**

Prior to the start of vegetation sampling, mark two sides of the meter square frame at distances of 0.224 m and 0.5 m mark along the side. These provide references for estimating the cut-off points of the cover scale ( 5%, 25%, 50%, 75%, and 100%).

At four random quadrats per transect place the meter square frame on the ground, over the vegetation. Use different random numbers for each transect. Place the frame parallel to and flush with the transect tape at the designated meter mark, on the opposite side of where you have been walking. Locate the frame to align with the random locations on the measuring tape.

Next measure the tallest *Phragmites* plant, an average *Phragmites* plant height and then count all of the live *Phragmites* stems within the quadrat and record all data in the appropriate column on Data Form C.

Then, in each quadrat, visually estimate cover per plant species, using the Daubenmire scale located on Form C. Note the total number of species of live, vascular plants in the quadrant. It is useful to record all plant species within the plot on the data sheet before estimating cover classes.

It is advisable to move vegetation aside to conduct this search. Next, make a visual estimate of the ranking of species by cover class. Beginning with the plant species with the greatest percent cover, identify the plant and estimate its cover class (Daubenmire scale on Form C). All plants included within the dominance list should be identified to species. If there is a plant species that cannot be identified, store some individual plant samples in zip-lock bags and bring them back to the office with appropriately labeled bags.